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PROMOTING SCIENCE FOR HUMAN DEVELOPMENT

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DEPARTMENT OF GEOSCIENCES

THE NEXUS BETWEEN CLIMATE CHANGE RISK PERCEPTIONS AND THE ADOPTION OF ADAPTIVE MEASURES AMONG SMALLHOLDER FARMERS IN CALUQUEMBE MUNICIPALITY, ANGOLA.

BY

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This dissertation is submitted to the Bindura University of Science Education in partial fulfilment of the requirements for the Master of Science in Climate Change and Sustainable Development Degree.

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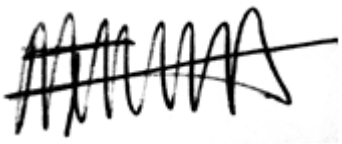
BINDURA, ZIMBABWE

APPROVAL

This dissertation, entitled **"The Nexus Between Climate Change Risk Perceptions and the Adoption of Adaptive Measures Among Smallholder Farmers in Caluquembe Municipality, Angola "** by Jabulani Garwi meets the regulations governing the award of the programme of **Master of Science in Climate Change and Sustainable Development**, and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature: ……  …….

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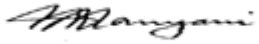
Chairman's Signature: ……  …….

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DECLARATION

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ABSTRACT

The phenomenon of climate change poses considerable challenges on a global scale, particularly for susceptible populations such as smallholder farmers. Evaluating these communities' comprehension of climate change and their corresponding reactions, while taking local knowledge into account, is of paramount importance. This inquiry investigates the correlation between the understanding of climate change risks among smallholder farmers and their adaptive practices in the Caluquembe Municipality of Angola. The study's primary objectives include exploring risk perceptions, adaptive approaches, and the correlation between perceived risks and the adoption of adaptation methods. Existing literature points to a scarcity of studies examining the link between climate risk perception and adaptation techniques in the context of smallholder farming in Angola. To bridge this knowledge gap, a pragmatic research perspective was adopted, synthesizing multiple research methodologies and data sources for a holistic understanding. A mixed-methods design incorporated both qualitative and quantitative methods. Multi-stage sampling, encompassing stratified and systematic random sampling techniques, was employed for data collection. Quantitative data was obtained from 80 household surveys, while qualitative data involved three focus groups and 10 key informant interviews, complemented by document reviews and field observations. Quantitative data was analyzed using SPSS, while qualitative information was examined through content analysis. The results revealed a high level of climate change awareness among farmers, with 73.75% being "Very aware" and 13.75% "Extremely aware." Most perceived climate change as a substantial threat due to elevated temperatures and reduced precipitation. Respondents reported significant impacts on income, crop yields, water quality, and availability. Common adaptive techniques included adjusting planting schedules and implementing water conservation practices. A positive correlation was identified between climate change risk awareness and the adoption of adaptation measures. Cross-tabulation analysis demonstrated a robust connection between climate change awareness and the implementation of adaptive strategies. Farmers with higher climate change risk awareness displayed a greater propensity to adopt a diverse array of adaptation techniques. On the other hand, those with lower awareness levels exhibited minimal adoption of these practices. However, the implementation of effective adaptation measures was hindered by various factors, including inadequate technological resources, restricted access to weather information, and insufficient human resources. In view of these outcomes, the research advocates for the government to assume an active part in devising enduring strategies to tackle the impacts of climate change on agriculture. This involves equipping farmers with state-of-the-art irrigation methods, and consistently updating them on sustainable farming techniques to ensure resilience against climate change effects.

Keywords: *Climate change, Smallholder farmers, Perception, Adaptation measures, Risk perception*

DEDICATION

This dissertation is dedicated to my beloved wife, Blessing, and dear son, Elroi, whose unwavering love and support have been my constant motivation throughout this academic journey.

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LIST OF ACRONYMS

FGDs	Focus Group Discussions
GIS	Geographic Information Systems
IFAD	International Fund for Agricultural Development
INAMET	National Institute for Meteorology and Geophysic of Angola
IPCC	Intergovernmental Panel on Climate Change
KIIs	Key Informant Interviews
NGOs	Non-Governmental Organizations
SPSS	Statistical Package for the Social Sciences
TPB	Theory of Planned Behavior
UNICEF	United Nations Children's Fund

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CHAPTER ONE

GENERAL INTRODUCTION

1.0 Background and Introduction of Study

This inquiry aims to examine the relationship between smallholder farmers' comprehension of climate change risks and the implementation of adaptive actions in the Caluquembe Municipality of Angola. Climate change is recognized as a multifaceted issue with far-reaching global consequences (Abbass et al, 2022). Developing nations are confronted with additional obstacles in tackling climate change, as it intensifies ongoing challenges related to poverty reduction and sustainable development (Asfew et al, 2023). Adaptation to climate change is critical for all nations, particularly those in the developing world grappling with the intricacies of climate variability (Dechezlepretre et al, 2022). The Intergovernmental Panel on Climate Change (IPCC) underlines the importance of a thorough understanding of adaptation alternatives and potential barriers (IPCC, 2021). However, prevailing studies on adaptation in Africa frequently produce generalized results and neglect the diverse array of adaptation strategies employed (Bedeke, 2023). The conventional top-down approach to adaptation, originating from international organizations and trickling down to national authorities, often fails to effectively reach and assist impoverished and at-risk populations or encourage community-driven initiatives (Kemp et al, 2022). To maximize the impact of global efforts, it is vital to align them with local contexts and bolster the adaptive capabilities of vulnerable communities (Portner et al, 2022).

In sub-Saharan Africa, smallholder farmers play a pivotal role, making substantial contributions to both food output and job creation (Fujimori et al, 2022; Bedeke, 2023). Despite their importance, their specific vulnerabilities to climate change are often overlooked (Isah et al, 2023). Understanding farmers' perceptions, cultural values, and knowledge-sharing practices related to climate change is crucial for effective adaptation strategies (Gomes, 2022). However, human behavior and perceptions of climate change remain poorly understood (IPCC, 2021). Thus, studying how communities perceive and respond to climate change, considering local knowledge and contexts, is necessary (Asfew et al, 2023; Bedeke, 2023).

The southern region of Angola is notably vulnerable to the adverse impacts of climate change, which significantly affect the area's environment and communities. The nation encounters considerable obstacles in addressing this environmental concern, largely due to its substantial dependence on rain-dependent agriculture, inadequate institutional capabilities, insufficient information on climate change, underutilization of water resources, and demographic strains (Pinto et al, 2023). Specifically, the provinces of Namibe, Huíla, and Cunene in the Southwest have been grappling with a prolonged drought since approximately 2010, characterized by irregular and below-average rainfall. This situation has resulted in an unprecedented environmental and humanitarian crisis, reaching its peak in 2019 when approximately 2.3 million people experienced food insecurity due to the drought (UNICEF, 2019). In response, the Angolan government, as well as national and international organizations, have initiated urgent aid and development programs to address the crisis.

Within this vulnerable setting, the Caluquembe Municipality in Angola's Huila province is especially susceptible to climate change-induced shocks due to its semi-arid environment and substantial dependence on agriculture. The local economy is centered around agriculture, with small-scale farmers relying on rain-dependent methods for their livelihoods. Climate change has resulted in increased temperatures and unpredictable rainfall patterns, jeopardizing agricultural production and endangering food security in the area, as substantiated by Kila et al. (2023). The municipality has already experienced several climate-related shocks, including prolonged dry spells, damaging floods, and soil degradation, which have inflicted severe repercussions on the local populace. Climate change impacts further extend to water resources, health, and infrastructure. Changes in rainfall and temperature trends are expected to disturb water accessibility, leading to water scarcity and heightened risks of waterborne illnesses (World Bank, 2022). Given Caluquembe Municipality's vulnerability to climate change-induced shocks, prompt action is crucial for both mitigation and adaptation to these adverse effects.

Despite the importance of studying climate change impacts, Angola, particularly the Caluquembe Municipality, has received insufficient research focus. This lack of attention contrasts with the growing body of research examining climate change consequences in neighboring nations like Namibia and Zambia (Thornton et al, 2022). Moreover, there is a

conspicuous scarcity of vulnerability assessments encompassing various social groups and ecosystems, hindering the comprehension of climate change vulnerability within the region. To address these shortcomings, this research intends to investigate smallholder farmers' climate risk perceptions and evaluate the interplay between their adaptation methods and perceived climate risks in the Caluquembe Municipality. By establishing a connection between awareness of climate risks and adaptive measures, the research seeks to provide insights into the dynamics of this relationship and bridge the research gap regarding smallholder farmers' experiences with climate change in Angola. The results of this study will prove crucial in identifying and tailoring adaptation strategies to alleviate anticipated effects of climate change on the welfare of smallholder farmers in Angola. Such efforts are vital in attaining sustainable development objectives related to poverty alleviation and livelihood security by 2030.

1.1 Problem Statement

The challenge of climate change is a significant global issue with substantial effects on developing countries such as Angola (Cain et al, 2015). In the Caluquembe Municipality of Angola, small-scale farmers are essential for ensuring food security and supporting rural economies. These farmers, however, encounter significant difficulties when adapting to climate change, mainly due to their reliance on rain-dependent agriculture. Erratic precipitation patterns, severe weather events like droughts and deluges, and increasing temperatures exacerbate their vulnerability (UNICEF, 2019). Despite these difficulties, there is a critical knowledge gap in understanding the views and comprehension of smallholder farmers regarding climate risks in the Caluquembe Municipality. Understanding these perceptions is vital as they affect individuals' capacity and motivation to address the risks (van Valkengoed & Steg, 2019). Introducing adaptation measures without accounting for insufficient risk perceptions may not yield the desired outcomes (Eitzinger et al, 2018). Unfortunately, this information is not widely accessible to communities and policymakers, emphasizing the need for research that investigates the connection between risk perceptions and adaptation strategies (van Valkengoed & Steg, 2019).

While earlier studies have analyzed the global consequences of climate change on agriculture, they often disregard the nuanced relationship between farmers' understanding of climate risks and the specific adaptive strategies they adopt in this particular context (Dow et al, 2013;

Arbuckle et al, 2015). Furthermore, the conventional top-down approach to climate change adaptation, which involves creating policies and decisions at higher levels and subsequently disseminating them to local communities, frequently fails to actively engage and address the specific needs of at-risk populations, such as smallholder farmers (Kettle & Dow, 2016; van Valkengoed & Steg, 2019). This approach, as a result, often leads to less effective and inclusive adaptation strategies.

To bridge these research gaps, this study aims to provide a comprehensive examination of the understanding and viewpoints held by smallholder farmers regarding climate risks in Caluquembe Municipality, Angola. The study seeks to address this knowledge gap by exploring the connection between risk perceptions and household adaptation strategies. By uncovering this relationship, stakeholders can better support communities in improving their risk perceptions and enhancing their resilience to climate change. Through a community-driven approach that prioritizes the voices of farmers, this study intends to contribute valuable insights to the expanding body of research on climate change and farmer risk perception. Ultimately, it seeks to shed light on this critical relationship and support stakeholders in their efforts to improve smallholder farmers' risk perceptions and overall resilience.

1.2 General Objective of the Study

The overarching aim of this study is to examine the nexus between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola.

1.3 Specific Objectives of the Study

To accomplish the primary goal, this study will concentrate on the following specific objectives:

- To assess the perceptions of smallholder farmers on climate change risk in Caluquembe Municipality.

  To examine the adaptive measures among smallholder farmers in response to climate change in Caluquembe Municipality.

- To explore the relationship between perceived risk and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality.

1.4 Main Research Question

What is the nexus between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola?

1.5 Specific Questions

To address the primary objective, the study will aim to answer the following specific questions:

- How do smallholder farmers in Caluquembe Municipality perceive the risks associated with climate change?
- What are the adaptive measures being adopted by smallholder farmers in Caluquembe Municipality in response to climate change?
- What is the relationship between perceived climate risk and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality?

1.6 Rationale and Significance of the Study

Investigating the connection between smallholder farmers' perceived climate change risks and their adoption of adaptive measures in Angola's Caluquembe Municipality holds considerable significance and offers numerous advantages for various stakeholders. From an academic perspective, this study contributes to the comprehension of climate change, advancing fields such as climate science, agricultural research, and sustainable development studies. It illuminates localized effects and the unique obstacles encountered by small-scale farmers. Additionally, the study tackles the pressing and pertinent matter of the nexus between climate change vulnerability and adaptation, considering the profound implications of global warming on poverty and development. With the persistent impacts of climate change and societal susceptibility, a comprehensive understanding of this topic is vital for various communities, geographic locations, and scholarly fields.

Policymakers can utilize the study's findings to develop evidence-based policies and interventions that enhance climate resilience in the agricultural sector and rural communities. By understanding farmers' perspectives and adaptation strategies, policymakers can design targeted climate change adaptation programs, agricultural policies, and disaster risk reduction strategies. Smallholder farmers themselves stand to benefit by gaining a deeper understanding of the specific climate risks they face and identifying context-specific solutions. The study's recommendations will empower farmers to make informed decisions regarding agricultural practices, resource management, and livelihood diversification, ultimately enhancing their resilience. Additionally, the findings will be valuable for donor and civic organizations, enabling them to align their projects and programs with the genuine needs and vulnerabilities of smallholder farmers. By incorporating the research insights, these organizations can allocate resources effectively, promote collaboration, and foster sustainability in development projects. Last but not least, the outcome of this study will guide the formulation of national climate change adaptation policies, rural development programs, and disaster management initiatives. This will empower the government and other stakeholders to focus on climate-resilient infrastructure, enhance agricultural services, and incorporate climate adaptation measures into wider development projects. In doing so, the study will contribute to fostering a more climate-resilient Angola.

1.7 Scope and De-Limitation of the Study

The scope and delimitation of this research are shaped by its emphasis on geographical context, local livelihood practices, and strategies for adapting to climate change. The study specifically investigates the Caluquembe Municipality in Angola, an area that has received comparatively little attention in terms of understanding the impacts of climate change on small-scale farmers. As a developing country within Sub-Saharan Africa, Angola experiences unique vulnerabilities due to insufficient infrastructure and communication systems. Past research has predominantly concentrated on coastal areas, overlooking the challenges faced by rural communities. This research strives to bridge this knowledge void by analyzing the consequences of climate change on the livelihood strategies of smallholder farmers in the Caluquembe Municipality. With regard to local livelihood practices, the study focuses on a mixed farming system common in the region.

In this system, farmers engage in both crop cultivation (maize, cassava, sorghum, millet) and livestock raising (cattle, goats, sheep) to sustain their households. Recognizing climate change impacts on this specific livelihood practice is critical, as marginalized communities are anticipated to suffer from disproportionate repercussions in the wake of changing climatic conditions. Moreover, the study prioritizes climate change adaptation over mitigation due to the urgent significance and policy implications of adaptation initiatives. Developing nations, like Angola, prioritize adaptation efforts to enhance their resilience and capacity to deal with the effects of climate change. This research aims to evaluate adaptation policies and strategies at various scales, thereby contributing to policy and research in this discipline.

1.8 Definition of the Key Terms

1.8.1 Climate - Climate is characterized as the extended-term sequence of atmospheric circumstances, encompassing variables such as temperature, rainfall, and wind, observed over many years. It should be distinguished from weather, which pertains to the short-term atmospheric conditions experienced on a daily or weekly basis, including events like temperature fluctuations, rainfall occurrences, and humidity levels (Fujimori et al, 2022).

1.8.2 Climate change - Climate change signifies considerable and persistent changes in the Earth's climate system, which can be linked to human activities like greenhouse gas emissions. These changes are evident over long periods and involve various aspects of the climate, such as temperature averages, precipitation trends, humidity, wind patterns, and other related factors. Climate variability, on the other hand, refers to natural, short-term variations in weather conditions, like the El Niño Southern Oscillation (Isah et al, 2023). In this study, both climate change and climate variability are regarded as forms of climate change, aligning with the definition provided by the IPCC, which considers any change in climate over time, irrespective of its cause, whether natural or human-induced (IPCC, 2021).

1.8.3 Global warming - The recorded surge in mean temperatures close to the Earth's surface and within the lowest atmospheric layer is referred to as global warming. This escalation is largely driven by human-induced greenhouse gas emissions. Global warming represents a particular

aspect of climate change and can instigate further shifts in climatic conditions, such as modifications in rainfall patterns (Kemp et al, 2022).

1.8.4 Climate Risk Perception - The concept of climate risk perception signifies individuals' unique comprehension and evaluation of climate change-related hazards and threats. It involves how people view and understand the probability and seriousness of adverse events connected to climate change, such as severe weather occurrences, rising sea levels, or shifts in temperature and precipitation trends (Kettle & Dow, 2016). Factors like personal encounters, cultural values, societal standards, and access to data shape an individual's climate risk perception. Comprehending climate risk perception is vital in creating successful strategies to manage and adapt to climate change because it significantly impacts people's choices concerning embracing adaptive actions and allocating resources to handle climate-associated concerns.

1.8.5 Vulnerability to climate change - The concept of vulnerability to climate change signifies the extent to which a system is prone to damage or negative effects stemming from exposure to climate hazards. It is shaped by numerous elements, such as the nature, scale, and pace of climate variations experienced by the system, its susceptibility to these shifts, and its capacity for adaptation. In essence, vulnerability is shaped by three primary elements: exposure, sensitivity, and adaptability. Exposure concerns the degree and type of susceptibility of a system to climate change, while sensitivity indicates how much the system is affected by climate-related pressures. Adaptability, on the other hand, refers to the system's ability to adjust its operations, practices, or structures in response to climate change (Kila, 2023).

1.8.6 Adaptation to climate change - Adapting to climate change involves the process of reacting and adjusting to the real or expected impacts of changing weather conditions, aiming to reduce harm or capitalize on potential benefits that may arise from such changes. In essence, adaptation represents a proactive approach taken by individuals and communities to mitigate the negative effects of climate fluctuations on their well-being, while also making use of the favorable aspects of their surroundings (Masud et al, 2017). Adaptation can take on various forms, including reactive versus proactive measures (timing), unplanned versus planned strategies (spontaneity), and actions at both individual and societal levels (scale) (Ndamani & Watanabe, 2015). Reactive or unplanned adaptation occurs in response to climate change, while proactive adaptation occurs

in anticipation or reaction to predicted climatic shifts (IPCC, 2021). Autonomous adaptation is driven by ecological changes in natural systems or by shifts in market and welfare conditions in human systems (IPCC, 2021). A related concept often contrasted with adaptation is maladaptation, which refers to situations where a strategy unintentionally increases vulnerability rather than reducing it.

1.8.7 Adaptive capacity - Adaptive capacity refers to the ability of a system or community to adjust and react to the impacts of climate change, with the goal of reducing potential harm, maximizing opportunities, or effectively handling the consequences. (Solomon, 2023). According to the IPCC, adaptive capacity represents the potential of a system or community to adjust its features in order to better handle current or anticipated external pressures (IPCC, 2021; Shukla et al, 2022). A system or community is regarded as possessing augmented adaptive capacity when it has the ability to modify its characteristics or behaviors in order to effectively manage shifts in external conditions. Resilience, a related concept, refers to the ability of a system, community, or society to adapt to challenges by resisting or changing to maintain or achieve an adequate level of functioning and structure (Thornton et al, 2022).

1.8.8 Mitigation of climate change - Climate change mitigation involves the execution of actions and interventions intended to lessen human-induced elements that drive transformations in the climate system. It includes measures and tactics aimed at decreasing the origins and discharges of greenhouse gases, in addition to improving the aptitude of natural or synthetic systems to soak up and accumulate these gases. A carbon sink is a storage facility or structure capable of amassing and conserving carbon-containing substances. Conversely, carbon sequestration refers to processes that remove carbon from the environment, resulting in a decrease in its concentration.

1.8.9 Livelihood - Livelihood refers to the diverse approaches and actions that households utilize to maintain their welfare and fulfill their fundamental needs. It encompasses the methods individuals use to acquire life's basic requirements, such as food, water, shelter, and clothing.

1.8.10 Poverty - Poverty, frequently discussed in developmental contexts, involves more than just a deficiency of income. It incorporates multiple dimensions of disadvantage, including

insufficient access to such essential social provisions as education, healthcare, and clean water, in addition to inadequate personal security and the capacity to engage in political decision-making processes affecting one's life (Thomas et al, 2019). Essentially, poverty constitutes a complex state marked by an absence of material assets, social prospects, and personal agency.

1.8.11 Sustainable livelihood - Sustainable livelihood denotes an approach to securing the means of life that can endure and rebound from an array of pressures and disruptions while sustaining or enhancing its capabilities and resources over time. This approach emphasizes the necessity of striking a balance between present needs and future welfare, guaranteeing the enduring feasibility of livelihood tactics and practices. Sustainable livelihood acknowledges the interconnectedness of social, economic, and environmental dimensions, striving to cultivate resilience, fairness, and the eco-friendly utilization of resources.

1.8.12 Smallholder farmers - Smallholder farmers are individuals who cultivate and manage small parcels of land, primarily for the purpose of growing crops to meet their own household's food needs. These farmers typically depend on the labor of family members and cultivate a variety of essential crops for their personal consumption, in addition to cultivating a few cash crops to generate additional income. Smallholder farmers may also be referred to by different names depending on the specific context and country, such as subsistence farmers, low-income farmers, or peasant farmers, among others. This group of farmers is distinguished by its small-scale nature, reliance on basic technologies, and relatively low levels of financial investment.

1.9 Structure of the Thesis

The dissertation is organized into five chapters, which are outlined as follows:

Chapter 1: The introductory chapter of the study is outlined in this section. It offers an overarching perspective of the research, encompassing the issue being examined and the layout of the study. Moreover, it presents the necessary contextual information to understand the research. This chapter sets the context for examining how smallholder farmers perceive and adapt to climate change risks. It outlines the rationale for the research, presents the research problem, main goal, specific aims, and the study's scope. The chapter further defines the delimitations and key terms utilized in the research.

Chapter 2: This chapter involves a thorough examination of existing literature on climate risk perception and adaptation measures among smallholder farmers. The review encompasses both global and regional as well as national studies, highlighting their interconnections. The significance and relevance of the theoretical frameworks employed in the thesis are also examined in this chapter. Furthermore, any gaps or limitations in previous literature are identified and discussed, thereby justifying the need for conducting this research in relation to previous studies.

Chapter 3: The focus of chapter three is the research methodology utilized in the thesis. It examines the research process and provides an overview of the data sources and research methods employed. The chapter outlines the specific techniques used for both theoretical and field research.

Chapter 4: The fourth chapter forms the crux of the thesis, as it revolves around the presentation, interpretation, and analysis of data. It serves as the central hub of the thesis, as all research conclusions, findings, and recommendations are derived from the data analyzed in this chapter.

Chapter 5: In this concluding chapter, a brief overview of the main discoveries of the study is presented, considering the research issue and the techniques employed to gather these insights. It emphasizes how the findings correspond with the study's aims. Lessons are derived from the significant discoveries, and suggestions are offered based on the study's outcomes, along with suggestions for future research avenues.

1.10 Chapter Summary

In this initial chapter, the foundation is set for an in-depth investigation into how smallholder farmers in the Caluquembe Municipality of Angola perceive the risks of climate change and implement adaptation measures. It establishes the contextual framework by emphasizing climate change as a global issue that disproportionately impacts developing countries. It also underscores the importance of adaptation, especially in regions prone to climate variability. The chapter emphasizes the significance of studying smallholder farmers' perceptions due to their vital role in food production and employment in sub-Saharan Africa, despite their frequent vulnerability to

climate change being overlooked. By clearly outlining the problem statement, objectives, research questions, significance, and scope, the study establishes a solid foundation for understanding the research context, setting clear goals, and defining the study's limitations. Following this, the next chapter conducts an extensive literature review, examining relevant studies in the field and significant works, with a particular focus on smallholder farmers' climate risk perception and adoption of adaptation measures.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents an in-depth review of the existing literature on how climate risks are perceived and the adaptive responses to climate change, highlighting their interrelations. The main aim is to enhance comprehension and critically assess the current literature, while pinpointing gaps for future investigation. Organized thematically, the literature review addresses crucial issues related to the study objectives, such as understanding smallholder farmers' perceptions of climate change risks, examining their adaptation strategies, and analyzing the link between perceived risks and the implementation of adaptive measures. Additionally, this chapter provides a detailed examination of the theoretical framework employed in the research, enriching the overall understanding of the subject.

2.1 Perceptions of Smallholder Farmers on Climate Change Risk

Numerous studies have examined smallholder farmers' understanding of climate-related risks and how they adapt to them. This research intends to expand upon this existing body of knowledge. Various academic fields have explored the concept of risk perception in the context of climate change, employing diverse conceptual frameworks for risk analysis (Shukla et al, 2022; Thornton et al, 2022). Risk, in this framework, is defined as the outcome of interactions between specific physical hazards and susceptible systems, taking into account factors like sensitivity and social vulnerability (Schneiderbauer et al, 2021). Moreover, risk can be understood as a combination of an event, its probability, and its repercussions (van Valkengoed & Steg, 2019). The risk perception approach views it as a collection of potentially damaging consequences that individuals anticipate based on available evidence concerning their occurrence, severity, and variability (Clayton, 2020). Effective analysis of climate change risks in agriculture is vital for devising sustainable adaptation strategies to cope with future risks. Two critical steps in risk analysis have been highlighted in the literature: recognizing and evaluating present climate variability, future climate change risks, and associated societal vulnerabilities. These steps underpin successful adaptation efforts (van Valkengoed & Steg, 2019). Due to

discrepancies between scientific risk assessments and individuals' subjective risk perceptions, interest in risk perception research has increased (Clayton, 2020). Prior findings indicate that farmers who don't acknowledge climate change or view it as a threat to their livelihoods are less inclined to implement adaptation or mitigation measures.

According to Ado et al (2020), risk perception refers to the intuitive judgments made by individuals and groups regarding risks in situations where information is limited and uncertain. It encompasses both an assessment of a specific threat's likelihood and the level of apprehension concerning its effects. Understanding how individuals perceive the risks associated with threats like climate change can provide valuable insights into their decision-making processes when it comes to taking protective actions and supporting government efforts in risk mitigation (Amani et al, 2022). Thus, evaluating both the probability and potential consequences of negative outcomes is crucial in understanding risk perception.

At present, the field of risk perception is mainly influenced by two key theories: the psychometric paradigm and cultural theory. According to Akano et al (2023), the psychometric paradigm posits that individuals tend to make quantitative assessments about the degree of risk, taking into account both their current and desired levels of risk. A central tenet of the psychometric paradigm is the subjective nature of risk. In contrast, cultural theory, as a social theory, emphasizes the connections among individuals and the societal connections with the natural environment (Apppiah & Guodaar, 2022). The literature suggests that risk perception significantly influences risk acceptance and attitude, which in turn, shapes decision-making processes related to risk. Thus, a more in-depth analysis of risk perception should consider the role of risk communication and how it affects behavioral changes or intentions through effective communication strategies.

In the realm of climate change, climate risk perception significantly impacts the success of climate change adaptation efforts within farming communities (Asare-Nuamah et al, 2019). Comprehending farmers' conceptualization and reactions to risks is paramount, as it shapes policies and programs promoting sustainable agriculture and conservation of natural resources (Asrat & Simane, 2018). Research on farmer risk perception has yielded valuable insights, such as the frequent discrepancy between perceived and actual risk, necessitating strategies to bridge

this gap (Assan et al, 2020). Moreover, even when individuals accurately gauge risk, their perception and intention to alter behavior may not always translate into tangible changes (Ayanlade et al, 2017). Azadi et al (2019) revealed that belief in climate change and personal encounters with crop failure contribute to understanding variations in farmers' risk perception. Balasha et al (2023) demonstrated that risk can simultaneously impede and catalyze the adoption of best management practices. These findings emphasize the intricate relationship between risk perception and farmers' decision-making, underscoring the necessity for nuanced strategies that address these intricacies.

A substantial amount of research has explored farmers' beliefs regarding climate change in various regions worldwide, such as China (Burnham & Ma, 2017), India (Etana et al, 2022), Central America (Feliciano & Sobenes, 2022), and the United States (Hitayezu et al, 2017). While farmers' beliefs about climate change may differ, most acknowledge its threat to local agriculture (Lamichhane et al, 2022). Nevertheless, there is limited knowledge regarding the perceptions of smallholder farmers in Angola's inland regions, with the exception of a study examining coastal communities' views of climate change (Cain et al, 2015). Given the differences coastal and agricultural communities, this research seeks to address this knowledge gap by investigating how smallholder farmers in Caluquembe Municipality perceive and respond to climate change-related risks. Conducting region-specific studies is crucial for developing effective policies and programs that encourage farmers to adopt climate change adaptation strategies.

Researchers have frequently employed Likert-type scales or risk assessment tools to gauge farmers' understanding of risks related to climate change in agriculture and other sectors. However, these studies mainly concentrated on the perceived severity of adverse outcomes, often overlooking the perceived probability of such events (Lasco et al, 2016; Li et al, 2017). The studies have explored a range of risk aspects, including the broad impacts of climate variability on farming operations (Mkonda et al, 2022; Ogundeji & Okolie, 2022) and specific impacts like drought and heat stress (Petersen-Rockney, 2022). Various risk levels and targets have been considered, from individual farmers to entire communities and future generations (Shrestha et al, 2022). Petersen-Rockney (2022) utilized a four-point Likert scale to investigate the concerns of

farmers in northern California regarding climate change's effects on drought, heat stress, extreme rainfall, and saturated soil. Their findings revealed significant apprehension among more than half of the farmers, particularly regarding drought and heat stress. Similarly, Mkonda et al (2022) employed five-point Likert scales to assess Tanzanian smallholder farmers' perceptions of climate change's impacts on their quality of life, input expenses, crop losses due to pests and diseases, and business investments. The majority of farmers expressed concerns about the potential impacts of climate change on input costs and productivity. These studies provide valuable insights into farmers' specific concerns, emphasizing the importance of considering both severity and probability when evaluating risk perceptions linked to climate change.

Two noteworthy studies have analyzed climate risk perceptions by considering both the severity and likelihood of harm. In one study, Lasco et al (2016) employed a three-level interval scale (0% - 5%, 5% - 10%, > 10%) to gauge Filipino farmers' expectations regarding climate change's impact on average yields and yield variability. Surprisingly, around 70% of the farmers did not anticipate significant effects, with most believing that climate change would not impact average yields and yield variability by more than 5%. In another seminal work, Li et al (2017) explored Hungarian farmers' outlook on the probability and seriousness of climate change impacts was investigated using a seven-point Likert scale. The researchers evaluated perceived climate change risks across multiple dimensions of farmers' lives, including physical health, income, assets, production, social connections, worries about personal losses, and overall well-being. Agricultural production emerged as the area with the highest perceived risk, with the highest average scores for both anticipated probability (5.71 out of 7) and expected severity (5.04 out of 7).

These studies offer significant insights into the use of the Likert scale for evaluating farmer climate risk perception. However, it is crucial to recognize that relying solely on this scale may not provide a complete understanding of the connection between perception of climate risks and the implementation of adaptive measures. To overcome this limitation, this study will supplement Likert scale questions with additional methods like open-ended interviews, providing a more holistic view of farmers' perceptions and behaviors related to climate risk. By adopting a

mixed-methods approach, this study endeavors to attain a holistic comprehension of farmers' encounters with and reactions to climate-induced risks.

Accurate comprehension of risk factors is fundamental for creating effective risk management systems, as highlighted by Asrat and Simane (2018). It is widely acknowledged in the literature that understanding farmers' risk perceptions is vital for designing policies and training programs that support agricultural risk management (Brussow et al, 2019). Perception and response to climate change risk differ substantially across countries (Amani et al, 2022), cultures (Asravor, 2022), and individuals (Etana et al, 2022), and can also evolve over time (Eitzinger et al, 2018). Risk perception is shaped by several elements, including the probability of occurrence, the gravity of consequences, and uncertainties involved (Moutouama et al, 2022). Public risk perception significantly influences political, economic, and social actions taken to address risks, either promoting or hindering such efforts (Nyang'au et al, 2021). The subjective nature of climate change risk perception leads to considerable variation in public concern and willingness to tackle the issue (Fujimori et al, 2022). Climate change's abstract and long-term nature as a centuries-long global phenomenon sets it apart from other ecological risks (Kemp, 2022), making it difficult for individuals to directly perceive and experience its anthropogenic impacts (Masud et al, 2017), thus contributing to a reduced sense of urgency in addressing the issue.

Van der Linden's 2015 climate change risk perception model, which explains nearly 70% of variance in risk perception, has been extensively utilized to elucidate variations in individual perceptions of climate change risk. The model encompasses four key dimensions: socio-demographics, cognitive factors (awareness of causes, impacts, and responses), experiential factors (emotions and personal experiences), and socio-cultural factors (social norms and values). Previous research indicates that farmers' climate risk perceptions are shaped by socio-economic factors pertaining to the farmers and their farms (Shukla et al, 2022). Additionally, divergent risk perceptions among farmers from different countries can stem from disparities in the likelihood of specific risk factors, variations in farmers' mentalities and awareness, or a combination of both (Thomas et al, 2019; Dechezleprêtre et al, 2022). Earlier studies have also recognized other factors influencing farmers' perceptions of climate risks, including drought,

yield fluctuations, market prices for agricultural goods, and occurrences of extreme weather events and natural disasters.

Employing van der Linden's model, Quarshie et al (2022) investigated climate change action across five East African nations, revealing a dual pathway to climate change action based on individual value systems. According to the study, people generally hold either self-enhancing values focusing on personal well-being or self-transcending values prioritizing the welfare of others. This dual pathway suggests that individuals with stronger self-enhancing values perceive lower climate change risk, leading to reduced likelihood of climate action. Conversely, those with stronger self-transcending values are more likely to engage in climate action (Quarshie et al, 2022). The research emphasizes significant influence of climate change risk perceptions on fostering climate-related initiatives, prompting further investigation into their impact on individual actions. These studies significantly enhance our understanding of variations in individual climate change risk perceptions, providing valuable insights for this research. Nonetheless, the present study goes further by examining the correlation between perception of climate change risks and the adoption of adaptive measures.

Several studies have built upon van der Linden's model of climate change risk perception, exploring factors contributing to variations in risk perceptions. One key determinant is climate change informedness, referring to individuals' knowledge of climate change. It's important to note that perceived informedness is subjective, as people often rely on indirect information sources that may be influenced by differing interests (Abbass et al, 2022). Accurate, scientifically valid information is essential given climate change's complex and gradual nature, yet there's a gap between public demand for information (e.g., rainfall data) and climate service providers' capacity to deliver it in Africa (Anderson et al, 2020; Bedeke, 2023). Alongside frequency of accessing climate change information, individuals' self-perception of their knowledge is crucial, although self-perceived knowledge may be biased and not reflect actual understanding (van der Linden, 2015). Therefore, a distinction is made between climate change informedness and beliefs. Van der Linden (2015) asserts that being aware of climate change is essential for understanding its risks, highlighting the significance of carefully selecting research

participants. Consequently, this study will take measures to ensure correct participant selection and inclusion in the research process.

Previous studies examining the impact of being informed about climate change on risk perceptions have produced inconsistent findings. While Arbuckle et al (2015) found a significant impact, Pearce-Higgins et al (2022) observed no substantial effect, linking this to participants' skepticism about climate change. Skeptical beliefs can make individuals less receptive to new information or uncertain about climate change impacts, thus questioning the connections between environmental changes and climate change (Pearce-Higgins et al, 2022). Understanding climate change information generation, communication, and its potential to challenge existing values is critical to uncovering the role of skepticism (Abid et al, 2015; Pearce-Higgins et al, 2022). Such insights benefit climate risk communication, potentially necessitating method and message adaptations to foster greater engagement (Abid et al, 2015; Anwar et al, 2015; Pearce-Higgins et al, 2022). The current study will evaluate research participants' climate change informedness and its influence on their climate risk perceptions.

Climate change beliefs significantly influence smallholder farmers' climate risk perception. Distinguishing between accurate climate change knowledge and individuals' beliefs is crucial, as emphasized by Bekuma et al (2023). Climate change beliefs cover various aspects, such as causes, effects, and reactions (van der Linden, 2015), varying based on factors like geographical location, occupation, and socio-economic, ecological, and cultural contexts (Asfew et al, 2023). Measuring these beliefs necessitates considering multiple dimensions, as awareness of climate change doesn't guarantee acceptance of its anthropogenic causes or transformative responses (Bekuma et al, 2023). Beliefs regarding climate change causes are particularly important, underpinning informed mitigation and adaptation responses (Bekuma et al, 2023). Precise causal beliefs play a crucial role in shaping behavioral intentions and backing for climate policies; conversely, erroneous beliefs have a notable impact on attitudes, inclination to take action, and endorsement of mitigation policies (Kemp et al, 2022).

Consequently, climate change beliefs substantially affect the perception of climate change risks and response actions. Precise climate change beliefs have been recognized as a vital factor in shaping individuals' perception of risks associated with climate change (van der Linden, 2015).

Studies in Pakistan's Punjab province revealed that respondents observed climate changes but were unfamiliar with the scientific concept of climate change (Abid et al, 2015). Similarly, a Seychelles village study showed that people were unaware of the global climate change phenomenon, believing the changes they observed were localized (Etongo et al, 2022). These observations underscore the influence of belief systems on climate risk perceptions among smallholder farmers, a critical aspect for the present study. While recognizing the importance of climate change beliefs in shaping risk perceptions, this investigation takes a step further by exploring the correlation between climate risk perception and adaptation. This analysis is essential for creating targeted and effective adaptation measures to support smallholder farmers in the face of climate change.

Climate change risk perception additionally entails how people evaluate the significance of climatic shocks in relation to other stress factors. Research examining wheat-producing communities in Australia (Anwar et al, 2015) and Iran (Azadi et al, 2019) revealed that these communities ascribed less importance to climate change impacts on their wheat crops than to changes in wheat prices, emphasizing the dominance of market forces over climate change. In contrast, African studies have highlighted farmers' acute awareness of warmer temperatures and decreasing precipitation (Hundera et al, 2019). For instance, studies conducted by Dzvimbo et al (2022) identified climate variability as the key driver of livelihood insecurity for Zimbabwean farmers, while Dick-Sagoe et al (2023) found that farmers in Lesotho were aware of erratic rainfall patterns and increasing hot days, significantly impacting their farming systems.

The varied findings from these studies emphasize the need for further examination of climate risk perception among smallholder farmers. This research aims to contribute to this area of inquiry. Additionally, the study expands upon existing literature by not only investigating climate risk perceptions among smallholder farmers but also probing the relationship between risk perception and adaptation measures adoption. Through this exploration, the study seeks to elucidate how risk perceptions shape farmers' choices to implement adaptation strategies, ultimately helping them address the challenges brought about by climate change.

2.2 Adaptive Measures among Smallholder Farmers in Response to Climate Change

Adaptation literature covers a broad spectrum of research, with adaptation being an inherent facet of human existence. Throughout history, societies have consistently demonstrated adaptability to changes, ensuring cultural survival (Etongo et al, 2022). However, adapting to climate change presents unprecedented and intricate challenges, exacerbated by the failure to adequately address poverty's root causes (Ado et al, 2020). The rapidly expanding body of knowledge on human communities' adaptation to climate change underscores its significance (Appiah & Guodaar, 2022; Bekuma et al, 2023; Chakauya et al, 2023; Likinaw et al, 2023; Mutengwa et al, 2023). Early studies defined adaptation as any adjustment made to alleviate anticipated negative impacts of climate change (Stakhi, as quoted in Eitzinger et al, 2018). Dechezleprêtre et al (2022: 86) defined it as a process, activity, or outcome within a system, such as a household or nation, that enables better coping, management, or adjustment to changing conditions. These definitions emphasize the dynamic nature of adaptation and the necessity for proactive measures to build resilience amidst evolving climatic conditions. Comprehending adaptation's complexities is crucial for devising effective strategies and policies that empower communities to tackle the challenges posed by climate change.

Adaptation strategies can be categorized using various criteria. One classification by Robert (cited in Etwire et al, 2022: 79) considers timing, temporal, and spatial aspects. Timing involves reactive adaptation (responding post-climate shock) and proactive adaptation (anticipating and preparing). Temporal scope includes strategic adjustments (long-term) and tactical adjustments (short-term). Spatially, adaptation can be localized (specific crops) or widespread (entire farming system). Another classification by Zilberman et al (cited in Tiet et al, 2022) distinguishes incremental and transformative adaptation, as well as reactive and proactive adaptation. Incremental adaptation denotes gradual improvements, while transformative adaptation involves systemic changes. Reactive adaptation responds to climate change impacts, while proactive adaptation seeks to prevent potential damage through preemptive actions.

While there is general agreement on the definitions of reactive and proactive adaptation, the precise practices and strategies within these categories may differ based on context and case study. For example, "changing the timing of sowing and harvesting" can be classified as either

proactive or reactive adaptation depending on local circumstances and farming systems. Steenkamp and Thebuho (2022) emphasize that a strategy or measure can fall into both categories depending on its nature, as a responsive action (reactive) or coping mechanism (proactive). Thus, adaptation strategy classification may vary based on the intricacies and contextual factors examined in each study.

Adaptation to climate change takes place at multiple levels, such as individual, household, community, and beyond. Household- or farm-level adaptation is typically autonomous, driven by individual decisions based on their unique circumstances (Talanow et al, 2021; Tofu et al, 2022). Meanwhile, government agencies generally engage in anticipatory and planned adaptation, which involves deliberate policy decisions recognizing the necessity to act due to evolving or imminent conditions (Twecan et al, 2022). Governments evaluate various social and economic objectives to manage climate change impacts (Fujimori et al, 2022: 35). The decision-making process considers climate change information and current behaviors at individual, community, and institutional levels to formulate suitable responses, highlighting adaptation as a dynamic social process where societal adaptive capacity is influenced by collective action (Kila, 2023). Consequently, collective action capacity is reflected in policies and initiatives implemented by community groups, government bodies, and non-governmental organizations, playing an essential role in coordinating adaptation efforts for an effective response to climate change challenges.

Most adaptation efforts are executed locally, making their effectiveness contingent on local institutions that shape individual and collective action incentives (Tesfahun & Chawla, 2020). For example, a study on local strategies in eastern Ethiopia's marginal environments reveals that farmer-led organizations and NGOs drive successful initiatives like reforestation, soil conservation, and efficient water harvesting, aimed at improving rural livelihoods (Tesfaye & Seifu, 2016). However, to be truly effective, local adaptation initiatives must align with national frameworks providing necessary resources and policy guidance. Recognizing the interplay between local and national adaptation domains is essential for successful and sustainable adaptation (Koirala et al, 2022). Acknowledging distinct domains and ensuring coordination between local and broader scales requires a thorough understanding of local conditions and

specific adaptation needs. By harmonizing local efforts with national strategies and resources, effective adaptation potential can be optimized across all levels.

Coping refers to instant human reactions to external disruptions, comprising various short-term actions during crises (Schneiderbauer et al, 2021). It happens within existing frameworks, while adaptation involves modifying the underlying structure where coping occurs, often through learning from past experiences (Megersa et al, 2022; Njoya et al, 2022). Some sociologists criticize using "strategy" alongside coping since it suggests deliberate and rational decision-making with a long-term perspective involving choice, power, and interaction (Pili & Ncube, 2022; Kom et al, 2022). In reality, coping mainly involves short-term actions, with decisions made without extensive deliberation or forethought, contrasting the typical strategy connotation. Using "strategy" alongside adaptation, and employing terms such as "actions," "measures," or "mechanisms" with coping, helps avoid conceptual ambiguity (Zobeidi et al, 2022).

Amid ongoing discussions on terminology, certain scholars perceive coping as an essential preliminary phase in adaptation, suggesting that short-term coping mechanisms may evolve into long-term adaptive strategies with time (Talanow et al, 2021; Purwanti et al, 2022). Conversely, some associate coping with temporary measures aimed at preserving or reinstating the existing state (van Valkengoed & Steg, 2019; Moutouama et al, 2022). In the Sahel context, Thornton et al (2022) emphasize that coping primarily aims to preserve household goals and individual/collective well-being, recognizing trade-offs and seemingly unsustainable strategies. Their argument revolves around the concept of coping as a rational and calculated reaction aimed at reducing the intensity or duration of crises, optimizing the utilization of limited resources, and ensuring the sustainability of livelihoods in the long term. Thus, resource mobilization and management flexibility become crucial for successful coping as rural Sahelians navigate multiple concurrent/successive needs and demands (Thornton et al, 2022: 47).

Farmers must continually balance competing needs and limited resources to safeguard their livelihoods, maintain consumption levels, preserve health, and uphold social status. Hundera et al (2019) illustrate specific coping measures Ethiopian farmers employed during the 1984 Wollo famine, which can be divided into five stages: austerity measures, decreased consumption, temporary migration, asset divestment, and crisis migration. Habtemariam (2016) suggests that

coping strategy effectiveness hinges on crisis type, timing, intensity, and individual resilience. Successful coping occurs when households mobilize enough resources to overcome adversity without jeopardizing long-term goals such as livelihood security (Asrat & Simane, 2018). Conversely, coping failure signifies selling critical assets, neglecting illness symptoms, and postponing important events like weddings and funerals or compromising health and nutritional requirements (Habtemariam, 2016). These indicators represent the difficulties households face when their coping strategies prove insufficient in managing crises.

Analyzing how households and communities mobilize and allocate resources during crises is vital, as it informs sustainable and effective development efforts. Understanding the roots, dynamics, and varying experiences of rural adversity, while supporting community and household coping mechanisms and risk reduction strategies, are key components (Chingala et al, 2017; Makuvaro et al, 2018). Hence, it is essential to evaluate the adaptation requirements and adaptive capabilities of smallholder farmers.

In research examining factors affecting adaptive capacity in Kenya's Masaba South Region, Nyang'au et al (2021) highlighted various significant factors. These include the availability of adaptive technology options, resource allocation, the organizational structure and decision-making processes of essential institutions, human and social capital, access to risk-sharing mechanisms, decision-makers' capacity for information management, and the public's perception of stressors. Etongo et al (2022) classified these factors into economic prosperity, technology, infrastructure, knowledge and skills, fairness, and institutional aspects. Institutions and governance-related concerns are frequently cited as significant obstacles to climate change adaptation (Balasha et al, 2023). While most factors are widely acknowledged, further investigation into the roles of networks and institutions in promoting or hindering effective adaptation strategies is necessary.

Critiques of climate modeling studies point out their tendency to downplay the importance of social and institutional networks in determining adaptive capacity (Ogundeji, 2022; Pili & Ncube, 2022). Emerging studies acknowledge the pivotal influence of both formal and informal institutions, along with social connections, in either facilitating or impeding climate change adaptation efforts (Mutengwa et al, 2023). Dick-Sagoe et al (2023: 74) outline two main roles in

this context: facilitation and implementation. Facilitation encompasses disseminating information, raising awareness, removing adaptation barriers, providing financial resources, and enhancing adaptive capacity. Implementation entails enacting tangible alterations in operational procedures and behaviors, as well as embracing novel technologies. While facilitation typically falls under the purview of external organizations, adaptation efforts can be undertaken by local communities, spanning from individual households to national or regional levels. At the national level, facilitation may entail integrating adaptation measures into overarching national development policies and initiatives (Dick-Sagoe et al, 2023).

Furthermore, research shows that social and institutional networks represent resilience and strength, enabling a social system to learn from past disasters, improve risk reduction measures, and secure better future protection (Thinda et al, 2020). In a complex world fraught with numerous hazards, fostering resilience and building the capability to adeptly address diverse threats emerges as indispensable for fostering sustainable development (Shukla et al, 2022). This necessitates a shift from short-term coping mechanisms to enduring, long-term adaptive approaches.

Adaptation strategies draw influence from various factors, including socio-cultural and economic dimensions, prior experiences with climate patterns, the policy framework in place, and individual perceptions of climate change risks (Pörtner, 2022). These strategies typically fall into three main categories: livelihood-based, sector-specific, and generational approaches. In the context of livelihoods, Dechezleprêtre et al (2022: 26) underscore that the adaptation pathways available to small-scale farmers hinge on contextual climate risks, geographic positioning, available resources, and livelihood tactics. Leveraging technical support such as satellite-based surveillance and Geographic Information Systems (GIS) for climate risk assessment can empower farmers to integrate traditional adaptive practices with cutting-edge knowledge. Advancements in computing technology further enhance climate data modeling, deepening our comprehension of climate patterns and their ramifications. Consequently, even remote regions can access accurate modeling insights and receive tailored support for climate change adaptation initiatives.

Within the livelihoods approach, comprehending climatic factors that shape farmers' perspectives on climate change is crucial (Asfew et al, 2023). Across Tanzania's diverse agroecological zones, a study identified six primary adaptation strategies, including the adjustment of crop planting schedules and the utilization of drought-resistant crop varieties (Mkonda et al, 2018). Similarly, investigations in the central highlands of Tanzania unveiled prevalent adaptation practices such as altering crop planting schedules, employing techniques for soil and water conservation, diversifying crop selections, initiating tree planting initiatives, and managing soil fertility (Shabani & Pauline, 2023). In Namibia's Zambezi Region, adaptation efforts included measures such as soil and water conservation, the implementation of water harvesting techniques, soil fertility enhancement through composting, tree plantation initiatives, and adjustments in cultivated land usage (Steenkamp & Thebuho, 2022). South Africa's crop production sector also witnessed adaptation strategies like crop diversification, modifications in crop types and varieties, and adjustments to agricultural timetables (Ogundeji, 2022). Likewise, in a study conducted in Southeast Zimbabwe, prevalent adaptation methods included mixed farming practices, diversified cropping approaches, alterations in crop planting schedules, the utilization of drought-resistant crop varieties, and the adoption of techniques for soil and water conservation (Chakauya et al, 2023).

In the sectoral approach to adaptation, Ojo and Baiyegunhi (2021) identified a plethora of technologies and practices tailored for agricultural climate change adaptation, encompassing water and soil management techniques, crop and livestock management practices, and various farming systems. Similarly, Batungwanayo (2023) emphasized the adaptive strategies utilized by smallholder farmers, such as implementing poly-culture systems, engaging in wild plant gathering, adopting mulching practices, harnessing local genetic diversity, and enhancing soil organic matter content. Exploring adaptation options and challenges in Southern African nations, Mafongoya et al (2022) uncovered common adaptation strategies, including the cultivation of different crops or varieties, tree plantation initiatives, soil conservation methods, adjustments to planting schedules, and the utilization of irrigation systems. Farmers across these countries appeared to derive significant benefits from access to extension services, credit facilities, and land resources. Particularly for the most impoverished farmers, support in the form of food aid,

extension services, and climate change information played a crucial role in facilitating adaptation to evolving environmental conditions.

In the context of the generational approach to adaptation, Kelly and Adger (cited in Abbass et al, 2022) categorized adaptation strategies into two generations. First-generation studies focused on hazards and impacts, employing vulnerability endpoint analysis to inform adaptation actions such as the implementation of irrigation and drainage systems, establishment of coastal setbacks, and even relocation of settlements, often supported by economic aid and institutional capacity enhancement efforts. Primarily addressing biophysical impacts, these approaches drew upon a range of methodologies including climate change scenarios, biophysical models, economic models, integrated systems models, empirical studies, and expert assessments to identify impacts and adaptation pathways (Likinaw et al, 2023).

On the other hand, second-generation adaptation studies shifted the focus towards social vulnerability to climate risks, as evidenced in research by Abid et al (2015) and Anwar et al (2015). Associated adaptation policies emphasized social dimensions over purely technical solutions, emphasizing poverty alleviation, diversification of livelihoods, protection of common property resources, and the strengthening of collective action. Agrawal's study (Abid et al, 2015) contributed valuable insights into adaptation strategies, categorizing them under five risk management strategies: diversification, communal pooling, storage, mobility, and market exchange. Among these, diversification emerged as the most prevalent and widely adopted strategy, distinguishing environmental change and policy (Kettle & Dow, 2016; Li et al, 2017). Livelihood diversification, as outlined by Ellis (cited in Etana et al, 2022: 46), involves rural households developing diverse activity portfolios and social support networks to withstand challenges and improve living standards. Other studies (e.g., Shrestha et al, 2022; Twecan et al, 2022) have linked livelihood strategies with risk management principles, enhancing resilience to stressors, securing existing livelihoods, and bolstering adaptive capacity for future changes.

Besides the three aforementioned approaches, literature on smallholder farmer climate change adaptation underscores the importance of personal responsibility and perceived climate change concern within social circles. Moutouama et al's (2022) study in Northern Benin showed that more informed participants felt less personally responsible and less concerned about climate

change, possibly due to information quality or overestimated self-reported knowledge. Evaluating frequently consulted information sources provides a comprehensive understanding of informedness beyond self-reported measures. Limited access to critical climate change information poses significant challenges for smallholder farmers, affecting awareness and adaptive abilities (Makate et al, 2017).

Researchers emphasize the influence of social norms on smallholder farmers' climate change adaptation behaviors and intentions (Nyang'au et al, 2021). Social norms define expected actions, thoughts, or feelings in certain situations (Van der Linden, 2015), encompassing descriptive social norms (actions others take against climate risks) and prescriptive social norms (perceived social pressure to view climate change as a risk requiring action). Studies show individuals with stronger connections to climate-focused networks exhibit higher individual climate adaptation levels (Jaeger et al, cited in Quarshie et al, 2022). Steynor et al (2021) also support the importance of social norms in predicting climate action. Multiple studies propose investigating social norms to inform climate change policy promotion (Lamichhane et al, 2022; Njoya et al, 2022). Steynor et al (2021) further demonstrate that social norms positively impact climate action across five East African countries. This research investigates how climate-related social norms may influence the climate-related behaviors of smallholder farmers within the study region.

In climate change adaptation literature, a key debate emerges over whether adaptation should focus solely on protection or serve as a catalyst for social transformation, scrutinizing the values driving environmental and developmental inequalities (Habtemariam et al, 2016: 32). This study examines local adaptation measures and investigates adaptation's potential for re-evaluating existing social contracts and addressing inequalities. One transformative opportunity lies in no-regrets adaptation, producing net social benefits regardless of climate change occurrence (Soubry et al, 2020). No-regrets adaptation actions bolster resilience and yield economic, social, and environmental advantages, even if climate scenarios don't materialize (Shrestha et al, 2022). IFAD (cited in Tofu et al, 2022: 33) highlights adaptation benefits such as sustainable income growth for smallholder farmers, progress towards poverty reduction and economic growth, enhanced environmental services, and reduced carbon emissions. Identifying and analyzing

successful adaptation practices among smallholder farmers is crucial to realize these benefits. Current research presents some examples like effective stakeholder involvement, holistic problem consideration, and adequate funding (Azadi et al, 2019). However, this list warrants further examination within smallholder farmer contexts and experiences.

Beyond exploring adaptation benefits, existing literature scrutinizes barriers obstructing adaptive measure adoption. These barriers impede or delay adaptation processes (Anderson et al, 2020; Masud et al, 2017). Examples in developed countries include leadership challenges, resource constraints, communication gaps, and conflicting values. In cross-country contexts, barriers encompass climate projection uncertainties, inadequate finances, and limited regional collaboration (Masud et al, 2017).

Research in several developing countries like the Democratic Republic of Congo (Amani et al, 2022), Ethiopia (Tesfahun & Chawla, 2020), Lesotho (Dick-Sagoe et al, 2023), Namibia (Steenkamp & Thebuho, 2022), South Africa (Ogundeji, 2022), Tanzania (Shabani & Pauline, 2023), and Zimbabwe (Makate et al, 2017; Mavhura et al, 2022) identified specific barriers: inadequate information, financial limitations, labor shortages, land scarcity, and suboptimal irrigation potential. A comparative study between Ethiopia and South Africa emphasized credit inaccessibility in South Africa and restricted land and information access as adaptation barriers (Thinda et al, 2020). Moreover, inadequate integration between researchers and relevant government agencies hampers coordination and communication (Clayton, 2020), with institutional and cultural barriers impeding effective translation of scientific knowledge into actionable plans that bolster adaptive capacity.

These studies offer crucial understanding of factors impeding adaptation. Correspondingly, the present study aims to scrutinize constraints on adaptive measures in the specific study area. Additionally, it endeavors to explore risk perception's connection with adaptation adoption—an under-investigated topic in prior research. While previous research has extensively discussed coping strategies and adaptation measures, there has been a notable gap in exploring the connections between farmers' perceptions of climate change risks and their coping and adaptation strategies. This study aims to bridge this gap by analyzing how risk perception

influences households' adaptive responses in the study area, contributing to a deeper understanding of this crucial relationship.

2.3 The Relationship between Perceived Climate Risk and the Adoption of Adaptive Measures among Smallholder Farmers

While some literature examines the relationship between climate risk perception and adaptation measure adoption, it remains scarce (Thomas et al, 2019). Certain studies on adaptation to natural hazards, including climate-induced ones, demonstrate that behavioral responses like adaptation willingness are significantly influenced by risk perception (Pörtner, 2022; Clayton, 2020). This perception reflects individuals' beliefs regarding hazard existence and characteristics (Clayton, 2020). Other studies stress the importance of farmers' concerns about climate change impacts for successful adaptation and mitigation. Ndamani and Watanabe (2015) argue that accurate risk perception is crucial for selecting effective coping strategies, as risk-unaware farmers cannot manage risks effectively. Similarly, Abid et al (2015) found that climate risk perception plays a pivotal role in farmers' adaptation attitudes in Pakistan. In Nepal, concerns about negative climate change impacts emerged as significant predictors of farmers' support for further protective measures and agricultural drainage investments to adapt to increased precipitation (Koirala et al, 2022).

A shared limitation among the research by Thomas et al, Pörtner, Ndamani, and Watanabe is the absence of targeted case studies that offer thorough examination. The broad scope of their work hinders detailed analysis. Likewise, although the research by Abid et al and Koirala et al is useful, their insights originate from areas beyond Africa. There is a demand for studies that focus exclusively on the African context. This project intends to enrich the sparse dialogue concerning the intersection of climate change perception and adaptation in Africa by carrying out case studies within the continent itself.

Prior research in developed nations has demonstrated a correlation between climate risk perception, recognition of environmental issues, attitudes toward solutions, and the willingness to implement these solutions in agriculture. Anwar et al (2015), for instance, examined agrarian communities in Australia, concluding that farmers' awareness of climate change impacts is vital

for successful adaptation and mitigation, with accurate risk perception key to choosing effective coping strategies. Petersen-Rockney (2022) studied farmers in northern California, finding a significant positive relationship between climate change beliefs and adaptation plans. Similarly, Abbass et al (2022) found that Dutch farmers who believe in climate change are more supportive of adaptation and mitigation actions. Feliciano and Sobenes (2022) also observed positive correlations in Central America. Conversely, Owen (2020) reported mixed results across Europe, with climate change beliefs linked to some adaptation strategies but not others. Shirvani (2020), examining actual adaptation in central Italy, found perceived climate change and risk to be significant factors driving farmers' adaptation decisions.

Despite the contributions of previous research, the existing literature on the connection between climate risk perception and adaptation primarily focuses on developed nations. The findings from these studies may not be directly applicable to developing countries. Specifically, the perception of climate risks in agriculture within African contexts, such as Angola, remains under-explored. This underscores the need for research examining the relationship between risk perception and adaptive measures in African settings. Consequently, this study aims to address this gap and enhance our understanding of farmers' attitudes and behaviors regarding climate change adaptation in Angola.

Studies investigating the correlation between smallholder farmers' perceptions of climate risk and their adaptation efforts in Africa have produced diverse findings. For instance, Jellason et al (2019) explored farmers in the Northwestern Nigerian Drylands and identified a link between long-term perceptions of climatic changes and previous experiences with drought, alongside a negative association between farming experience and the belief in increasingly severe droughts. In Tanzania, Brussow et al (2019) and Batungwanayo et al (2023) observed similar patterns, highlighting how climate change experiences shape risk perceptions. Brussow et al (2019) noted that perceived declines in past water availability heightened farmers' concerns about future water resources and global climate change, influencing their inclination towards adopting mitigation and adaptation measures. Similarly, Batungwanayo et al (2023) found a positive impact of past experiences with climate change-related events on risk perceptions.

Contrary to these findings, Kom et al (2022) discovered no link between perceived climate risk perception and adaptation measures in South Africa's Vhembe District. Instead, they found resource availability and cultural factors to be more impactful, a finding supported by Bedeke (2023) in a survey across Sub-Saharan Africa. While these studies offer valuable insights into the association between climate change risk perceptions and adaptation among smallholder farmers in other African regions, there is a dearth of such research in Angola. This study aims to address this gap by exploring the connection between climate risk perception and the adoption of adaptive measures among smallholder farmers in Angola's Caluquembe Municipality.

An extensive review of the literature exposes a noticeable lack of scholarly inquiry into the precise connection between climate risk perceptions and adaptation measures among small-scale farmers. Current studies often emphasize either risk perception or adaptation measures individually, neglecting their interplay. Furthermore, most research on this topic originates from developed nations, with minimal representation from Africa. Even among studies conducted in Africa, none have specifically addressed Angola's situation. This gap in the literature underscores the necessity for a thorough examination of climate risk perception, adoption of adaptive measures, and factors influencing farmers' choices within Angola's small-scale farming sector. This research endeavors to fill this informational void and enhance understanding of climate change within Angola's agricultural sector post-independence, an area that has garnered less scrutiny in comparison to coastal regions.

2.4 Theoretical Framework

Employing the Theory of Planned Behavior (TPB), introduced by Ajzen in 1985, this investigation examines how smallholder farmers' perceptions of climate change risks relate to their adoption of adaptive measures within the Caluquembe Municipality of Angola. The TPB offers a comprehensive framework for understanding the factors influencing human behavior (Ajzen, 2020). It posits that three main components shape human behavior: attitudes, subjective norms, and perceived behavioral control, illustrated in Figure 2.1. These factors significantly shape individuals' intentions and consequent actions.

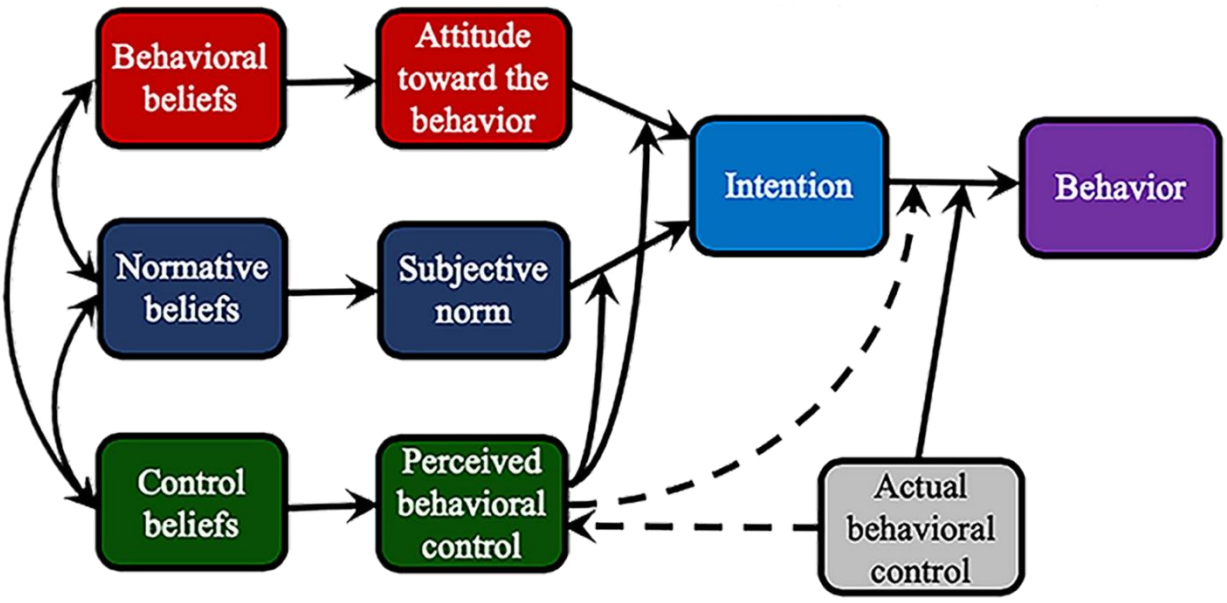

Figure 2.1: Graphical depiction of the theory of planned behaviour (Ajzen, 2020)

Attitudes encompass individuals' assessments or convictions regarding the anticipated consequences of their actions. In this study's context, attitudes involve smallholder farmers' perspectives on climate change risks and their appraisal of potential advantages or disadvantages linked to adopting adaptive measures. Farmers who perceive climate change as a considerable risk and trust that adaptive measures can effectively lessen its impacts are more inclined to possess positive attitudes towards adopting these measures. Attitudes significantly influence intentions and consequent behaviors.

Subjective norms represent the social pressures and expectations individuals perceive from their social environment. They encompass the perceived social norms, beliefs, and opinions of others who are considered important to the individual (Ajzen, 2020). In the case of smallholder farmers, subjective norms can include the influence of their peers, family members, extension agents, and community leaders. These norms can either facilitate or impede the adoption of adaptive measures. If farmers perceive that their social network supports and encourages the adoption of adaptive measures, it is more likely to positively influence their intentions and behaviors.

Perceived behavioral control revolves around individuals' convictions regarding their level of control over their actions. It encompasses aspects such as knowledge, skills, resources, and perceived impediments or enablers that can impact the adoption of adaptive measures (Ajzen, 2020). Smallholder farmers' belief in possessing the requisite resources, skills, and backing for climate change adaptation bolsters their perceived behavioral control. Elevated levels of perceived behavioral control heighten the likelihood of favorable intentions and actual behavior adoption.

According to the Theory of Planned Behavior (TPB), individuals' intentions and subsequent behaviors are influenced by their attitudes, subjective norms, and perceived behavioral control. Intentions symbolize an individual's preparedness and eagerness to execute a particular action (Ajzen, 2020). In this study's context, intentions mirror smallholder farmers' aspirations and strategies for adopting adaptive measures to counteract climate change risks.

Prior research has integrated the TPB framework, comprising attitudes, subjective norms, and perceived behavioral control, as forecasters of both behavioral intention and actual conduct (Zhang et al, 2020). The influence of these predictors on intentions may fluctuate across different contexts. In some instances, attitudes alone may substantially impact intentions, while in others, both attitudes and perceived behavioral control contribute to intention formation. Furthermore, there are situations where all three predictors independently impact intention strength (Chen, 2020; Correia et al, 2022). This study specifically examines small-scale farmers' perceptions of climate change risks, their attitudes toward embracing adaptive measures, subjective norms from their social networks, and perceived behavioral control factors. The study aims to analyze how these factors shape farmers' intentions to adopt adaptive measures and their subsequent actions. By utilizing the TPB framework, this study endeavors to offer a more profound comprehension of the fundamental elements impacting small-scale farmers' decision-making processes concerning climate change adaptation. The framework facilitates an investigation of the interplay between risk perceptions, attitudes, subjective norms, and perceived behavioral control. Comprehending these factors will assist in devising targeted interventions, policies, and strategies to amplify the adoption of adaptive measures among small-scale farmers in Caluquembe Municipality.

In summary, the TPB offers a solid theoretical basis for studying the connection between climate change risk perceptions and embracing adaptive measures. By evaluating attitudes, subjective norms, and perceived behavioral control components, this study will unveil the elements impacting smallholder farmers' intentions and actions. This knowledge will ultimately aid in devising successful strategies for climate change adaptation within the agricultural sector.

2.5 Chapter Summary

This chapter presented a thorough examination of the prevailing literature concerning climate risk perception, adaptation to climate change, and their interconnections. To address the study's core objectives, the literature review was organized thematically. These objectives encompassed assessing smallholder farmers' perceived climate change risks, identifying the adaptive measures they employ to tackle climate change, and probing the connection between perceived risk and adoption of adaptive measures among small-scale farmers. The chapter also offered a detailed examination of the theoretical framework used in this study, enriching comprehension of the subject. The next chapter will present a comprehensive explanation of the research methodology employed in this study, shedding light on the methods used to tackle the research questions.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

Having presented an exhaustive examination of climate risk perception and adaptation literature in the previous chapter, this chapter delineates the research methodology used in this study. It explores the study area, research philosophy, approach, design, sample, data collection, and analysis methods. The central objective was to analyze the connection between small-scale farmers' climate change risk perceptions and their adoption of adaptive measures in Caluquembe Municipality, Angola. This chapter validates the chosen methodology and evaluates its merits and limitations concerning the research objectives.

3.1 Description of the Study area

The research focused on Caluquembe Municipality, nestled in Angola's southwestern Huila Province (Fig 3.2). Positioned in Huila Province's northern sector, Caluquembe Municipality shares boundaries with various adjacent municipalities. To the north, it borders Ganda; to the east, it borders Caconda, Chicomba, and Matala; to the south, it borders Quipungo; and to the west, it borders Cacula, Quilengues, and Chongoroi. Caluquembe Municipality covers an estimated area of 2,941 square kilometers, which is about 10 percent of the total area of the entire province (CIDE-ISCED Huila, 2020). Within Caluquembe Municipality, there are three communes: Caluquembe, Ngola, and Calepe. These communes have a combined population of approximately 179,931 people, based on estimates from 2019. The most populated commune is Caluquembe, with about 96,099 people and covering an area of approximately 1,150 square kilometers. Ngola commune has about 53,132 people and covers an area of about 1,140 square kilometers, while Calepe commune has about 30,700 people and an area of approximately 561 square kilometers (CIDE-ISCED, 2020). Huíla Province, where Caluquembe Municipality is located, is a vast region spanning approximately 79,023 square kilometers. The province has an estimated population of around 3,444,756 individuals. It shares borders with Namibe and Benguela provinces to the west, Benguela and Huambo provinces to the north, Bié and Cuando Cubango provinces to the east, and Cunene province to the south. The population of Huila

Province is characterized by ethnic diversity, with the Herero, Ovimbundu, Nyangela, and Nyaneca-Nkhumbi being the four major ethnic groups. These ethnic groups contribute to the cultural richness and diversity of the region (CIDE-ISCED, 2020).

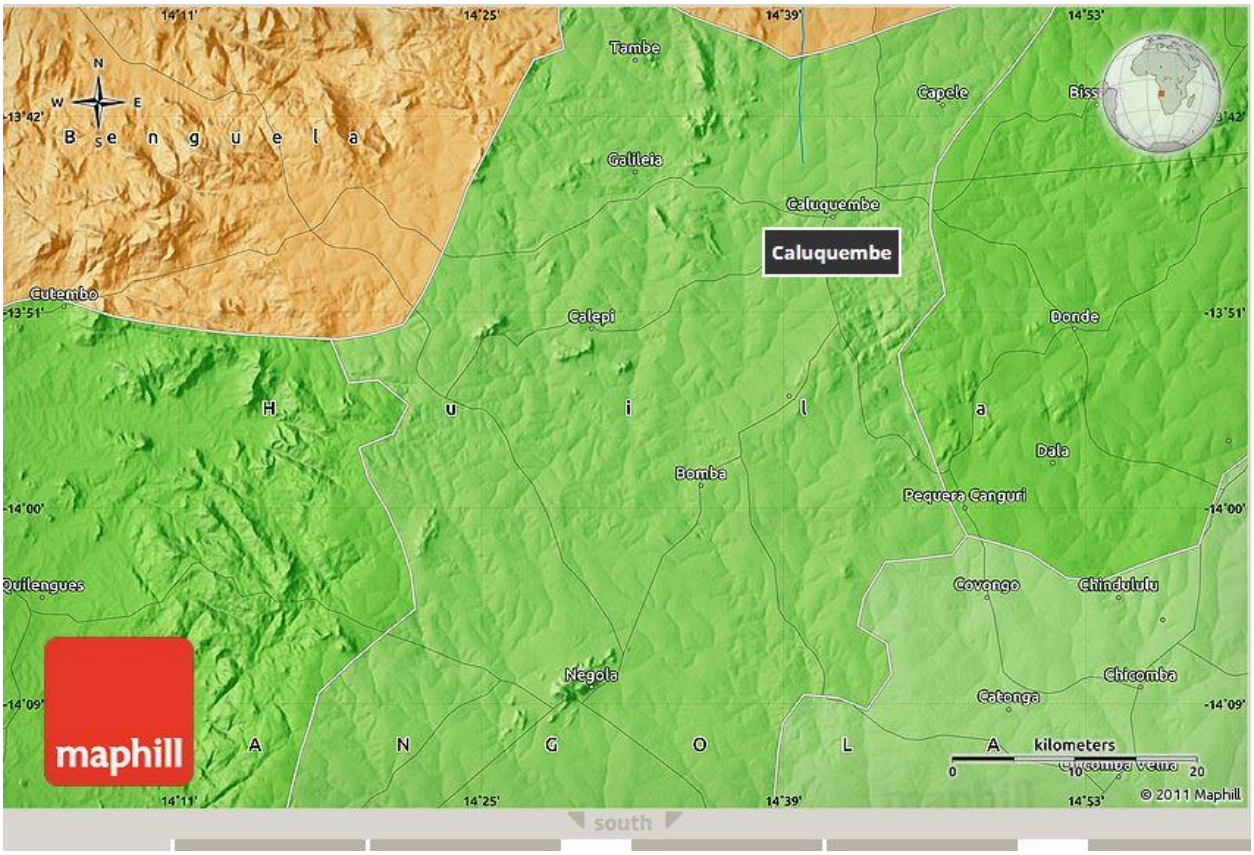

Figure 3. 2: Map of Angola showing Caluquembe Municipality in Huila Province

The study area in Caluquembe Municipality, Angola, is characterized by semi-arid conditions and sparse vegetation, with predominantly sandy soils. It is situated in a lowland region that experiences irregular and variable rainfall patterns. The primary livelihood strategy for smallholder farming communities in the area is mixed farming, combining both crops and livestock. The most commonly cultivated crops include *massambala* (sorghum), *masango* (millet), cassava, and maize. Livestock farming encompasses raising goats, cows, donkeys, sheep, and poultry. However, the area's extreme aridity hinders both crop production and livestock farming. Droughts frequently occur, causing food shortages and significant dependence

on humanitarian assistance. Mean yearly temperatures fluctuate between 25 and 44 degrees Celsius, while average annual precipitation ranges from 100 mm to 400 mm (INAMET, 2021). Rainfall is unreliable, unpredictable, and unevenly distributed throughout the province. These erratic rainfall patterns have contributed to low crop productivity and increased food insecurity. Moreover, the unpredictable nature of the rainfall has negatively impacted the sustainability of the crop-livestock mixed farming system, which is vital for sustaining livelihoods in the area. Farmers face difficulties in planning their agricultural activities and struggle to maintain consistent yields due to the inconsistent water supply.

3.2 Research Philosophy

Employing a pragmatic research philosophy, the study acknowledges reality's intricacy and enables the utilization of versatile, problem-solving techniques to fulfill the research objectives. Given the difficulties in acquiring adequate data aligning with purely positivist or qualitative worldviews in the Caluquembe Municipality context, this approach proves fitting. Pragmatism stresses practical knowledge application and method selection for effectively tackling research questions. It promotes integrating various viewpoints, methodologies, and data sources for a thorough topic understanding. The researcher's field visit and interactions with smallholder farmers enabled exploring their perspectives and meanings, fostering a more nuanced investigation of the research topic and ground-level actualities.

3.3 Research Approach

The study employs a mixed methods approach, fusing qualitative and quantitative research techniques, to achieve an all-encompassing comprehension of the research topic. (Budianto, 2020; Snyder, 2019; Pandey & Pandey, 2021; Newman & Gough, 2020; Greening, 2019; Dodds & Hess, 2020). The qualitative methodology was employed to gain insights into the values and perceptions of smallholder farmers, which are difficult to quantify, allowing the researcher to explore how these farmers interpret and give meaning to their experiences and the broader world around them. The quantitative approach was used to provide statistical rigor and enhance the overall understanding of the research topic. The mixed methods approach, rooted in a pragmatic

research philosophy, allows for the integration of multiple perspectives and data sources to address the research questions effectively.

3.4 Study Design

Research design is vital, offering a thorough plan and framework for investigation, ensuring data relevance to research objectives and effective question addressing (Sileyew, 2019; Zawack-Richter et al, 2020). This study aimed to fit within a case study design's epistemological structure, evaluating perceived climate risk and adaptive measure adoption connections among small-scale farmers in the chosen area. As an empirical inquiry instrument, the case study method investigates real-life phenomena, fittingly answering "how" and "what" questions for this study's focus (Siedlecki, 2020: 110).

3.4.1 Justification of case study research design

Selecting a case study design for this research is justified by several reasons. Firstly, it facilitates in-depth exploration of real-life phenomena (Siedlecki, 2020). Secondly, case studies suitably address "how" and "what" questions (Siedlecki, 2020), matching this study's objectives: assessing smallholder farmers' climate change risk perceptions, examining their adaptive measures, and probing perceived risk and adoption connections. Furthermore, case studies enable rich, contextual data collection via interviews, observations, and document analysis, enhancing findings' validity and reliability (Yin, 2018). Lastly, case studies capture complexities in dynamic settings, considering local contexts, cultural factors, and challenges faced by small-scale farmers in Caluquembe Municipality (Siedlecki, 2020). In essence, the case study design aptly investigates climate change risk perception and adaptive measure adoption relationships among small-scale farmers in Caluquembe Municipality.

3.5 Population, Sample size and Sampling Techniques

3.5.1 Population

The target population for this study consists of all the registered farm households located within Caluquembe Municipality, as specified by Singh (2022:34). These farm households engage in smallholder farming within the same ecological zone and operate under the jurisdiction of the

municipality. It is essential for the population to have shared characteristics that are relevant to the research objectives (Malhotra as cited in Singh, 2022: 33). In this case, the targeted farmers in the study area were specifically selected because they are involved in smallholder farming production within the same ecological zone, operating under three communes. This shared occupation and geographic location make them a cohesive and appropriate population for the study. To identify and access the target population, the authorities of Caluquembe Municipality provided a list of registered farmers in the area. All three communes were considered for the study, and the household farm unit was chosen as the primary sampling unit. Each individual household was treated as a separate data point for the study. Table 3.1 below offers an overview of the target population, including registered farm household numbers in each commune and the total number of registered farm households in Caluquembe Municipality

Table 3.1: Target population

Geographical Area	**Calenga Commune**
Ecologica Zone	Tropical Semi-Arid Climate
Population Size	All the registered farm households
Selection Criteria	Smallholder Farm Households within the specified ecological zone
Sampling Unit	Household Farm Unit

Source: Researcher, (2024)

3.5.2. Sample size

In research, data can be collected through a census or sampling. A census gathers information from every individual in the population but is costly and time-consuming. Sampling selects a representative subset, reducing expenses and saving time (Indu & Vidhukumar, 2019; Bloomfield & Fisher, 2019). The study's sample size was thoughtfully established considering the research questions and methodological approach. For qualitative data, 18 farmers were divided into three focus groups (FGDs), and 10 key informants were interviewed, including 5 from the government and 5 from NGOs. For quantitative data, 80 household heads were

surveyed, balancing financial resources and the need for a representative sample (Gaus, 2017). Notably, given that the study also has a qualitative component of inquiry, the issue of sample size is not of significant concern. In qualitative research, sample size is flexible, depending on the study's objectives and available resources, aiming for depth or breadth of insights (De Vaus, 2001; Gaus, 2017; Indu & Vidhukumar, 2019). Table 3.2 below summarizes the sample structure.

Table 3.2: Sample size

Type of Respondents	Number of Respondents	Percentage	Sampling Technique
Government Officials	5	6	Purposive Sampling
Farming Community Members	80	88	Systematic Random Sampling
NGO Representative	5	6	Purposive Sampling
Total	90	100	

Source: Researcher, (2024)

The table indicates the sample included these respondents:

- 5 government officials sharing insights on smallholder farmers' climate change risk perceptions and adaptive measure adoption in Caluquembe Municipality.
- 80 farming community members who shared their perspectives on climate change risk and adoption of adaptive measures in the study area.
- 5 representatives from the NGOs who shared their experiences related to adoption of adaptive measures among the smallholder farmers

3.5.3 Sampling Procedure

The study's sampling procedure entailed choosing participants for focus group discussions (FGDs), key informant interviews, and quantitative surveys, varying by data collection type and specific objectives. For FGDs, 6 farmers from each of the three sites were deliberately selected, factoring in gender for diverse representation. Chosen farmers lived in the area for two decades or more, spanning various age ranges, capturing climate change and agriculture-related experiences and perspectives. Key informant interview participant selection employed purposive sampling. Knowledgeable and experienced individuals in climate change policy-making or implementation were selected, including those responsible for policy creation and/or implementation in their respective organizations. The sample consisted of 10 participants from government and NGOs.

A multi-stage sampling procedure was employed to ensure the selection of a representative sample for the quantitative survey. The sampling procedure combines stratified sampling with systematic random sampling. Stratified sampling involves dividing the subjects into subgroups called strata based on shared characteristics (Gaus, 2017). In this case, the population naturally occured in distinct groups called communes: Caluquembe, Ngola, and Calepe. The participants of the study share common characteristics, such as living in the same ecological region and practicing mixed farming. To select participants for the quantitative survey, a systematic random sampling technique was used within each commune. This method is efficient and representative for large populations. The sampling frame included the entire population of the municipality, including residents from all three communes. To ensure a representative sample, the sampling process involved stratified sampling with proportionate allocation, followed by systematic random sampling within the communes. The Caluquembe Municipality comprises three communes with different population sizes: Caluquembe (approximately 96,099 people), Ngola (approximately 53,132 people), and Calepe (approximately 30,700 people).

The proportionate allocation method was employed to determine the number of participants selected from each commune. This method took into account the relative sizes of the communes in the population, ensuring an accurate reflection of the population distribution. The formula

used to determine the number of respondents from each subgroup in a systematic random sampling approach is:

Number of Respondents from a Subgroup = (Proportion of Subgroup Population) x (Total Sample Size)

Using this formula, the number of respondents selected from each commune was determined while maintaining proportionality with the population demographics. For example, in the case of the Caluquembe Commune:

- Population: Approximately 96,099 people
- Proportion of the Total Population: (96,099 / 179,931) ≈ 53.4%
- Number of Respondents: 43 respondents were selected from the Caluquembe Commune.

Similar calculations were performed for the Ngola and Calepe communes to ensure an accurate representation of the population distribution across all three communes within the municipality.

Ngola Commune:

- Population: Approximately 53,132 people
- Proportion of the Total Population: (53,132 / 179,931) ≈ 29.5%
- Number of Respondents: 24 respondents were chosen from the Ngola Commune.

Calepe Commune:

- Population: Approximately 30,700 people
- Proportion of the Total Population: (30,700 / 179,931) ≈ 17.1%
- Number of Respondents: 13 respondents represented the Calepe Commune.

Based on these calculations, out of the total sample size of 80 respondents, 43 were from the Caluquembe commune, 24 from Ngola, and 13 from Calepe. This approach ensured that the sample accurately reflects the population distribution across all three communes within the municipality, capturing the diversity of individual farmers.

Focusing on the household level stems from the notion that rural households function as primary economic entities deciding on production and consumption. Individual household heads serve as data collection and analysis units, providing vital insights into agricultural climate adaptation strategies. Research suggests household-level decisions are shaped by subjective factors, including risk perception, age, gender, preferences, and social status.

3.6 Data Collection Methods

A combined qualitative and quantitative data collection approach addressed research objectives comprehensively. Qualitative methods explored risk perception and adaptive measure adoption questions, involving in-depth interviews and focus group discussions with small-scale farmers. These methods allowed understanding farmers' perspectives, experiences, and decision-making about climate change risks and adaptive measures, yielding rich, nuanced data capturing view complexity. Quantitative methods investigated adaptive capacity and household characteristics questions, employing structured questionnaires administered to Caluquembe Municipality small-scale farmers. Questionnaires comprised closed-ended and Likert scale items, enabling standardized responses. Researchers gathered numerical data on farmers' climate change risk perceptions and adaptive measure adoption levels, with statistical analysis identifying patterns and relationships. Table 3.3 outlines research objectives, questions, data collection methods, data needs, and sources.

Table 3.3: Research Objectives, Research Questions, Data Collection Methods, Data Needs, and Data Sources

Research objectives		**Research Questions**	**Data needs**	**Data sources & collection methods**
To assess the perceptions of smallholder farmers on climate change risk in Caluquembe Municipality.		How do smallholder farmers in Caluquembe Municipality perceive the risks associated with climate change?	Information on farmers' risk perceptions, attitudes, and beliefs related to climate change	Qualitative (Semi-structured interviews with farmers, and policy makers, FGDs) Quantitative (Survey)

To examine the adaptive measures among smallholder farmers in response to climate change in Caluquembe Municipality.		What are the current adaptive measures being adopted by smallholder farmers in Caluquembe Municipality to mitigate the impacts of climate change?	Data on the specific adaptive measures smallholder farmers are using to address climate change.	Qualitative (Semi-structured interviews with farmers, and policy makers, FGDs) Quantitative (Structured questionnaires with closed-ended questions and Likert scale items.)
Explore the relationship between perceived risk and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality.		What is the relationship between perceived climate risk and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality?	Data that helps establish the connection between risk perceptions and the adoption of adaptive measures.	Qualitative (Semi-structured interviews with farmers, and policy makers, FGDs) Quantitative: Structured questionnaires with Likert scale items.

Source Researcher, (2024)

Besides primary data collection, secondary data was compiled from published documents about Angola's climate change-related policies, laws, and measures. A small amount of data was gathered through direct participant observation and field visits, with pertinent information documented during these trips.

3.7 Structure of data collection tools

The qualitative and quantitative data used in this thesis was collected from a mixture of primary and secondary data sources. The use various methods of data gathering provides for triangulation, which enhances the reliability of the research. The usage of the various sources of data is explained below. The study's data collection instruments are meticulously crafted to capture quantitative and qualitative climate change risk perception and adaptive measure adoption information from small-scale farmers. The data collection methods include structured questionnaires, interview guides, and FGDs guides.

3.7.1 Household Survey Questionnaire

Stuart and Nicola (in Urcia, 2021:32) distinguish surveys into cross-sectional and longitudinal categories. Cross-sectional surveys collect data at a specific moment, like household surveys gathering individual experiences about an event, project, or initiative. This type of survey questionnaire can help identify the connection between two components, such as the contribution of a program to the lives of individuals or the community involved (Urcia, 2021). On the other hand, longitudinal surveys involve collecting data over a long period of time. This type of survey allows researchers to examine developments and changes in the target population over time and take them into account (Bairagi & Munot, 2019).

This research utilized a cross-sectional survey via questionnaire administration. Questionnaires collect specific, relevant information through research questions posed to respondents, aiming for four primary goals: gathering suitable data, enabling easy data comparison and analysis, minimizing bias in framing and asking questions, and making questions engaging and diverse. The target audience for this study's questionnaire was primarily household heads or designated members of Caluquembe's small-scale farming community. The questionnaire incorporated both closed-ended and open-ended questions. Closed-ended questions provide structured objectivity in research, are easily administered, and require less analysis effort. Predefined questions featured closed-ended response options and Likert scale items, with most requiring "YES" or "NO" answers, and respondents ticking their choices. Despite providing comparative,

quantifiable data, closed-ended questions occasionally missed respondents' deeper feelings and perceptions about the researched topic.

Open-ended questions were included in the study, aligning with qualitative research suggestions by Babbie and Mouton (in Patel & Patel, 2019:34). Unlike structured closed-ended questions, open-ended questions allowed respondents to freely express belief systems, feelings, and recommendations concerning climate risk perception and adaptive measure adoption among Caluquembe Municipality's small-scale farmers. The researcher managed responses through question standardization, explained in the research design, while minimizing open-ended questions to encourage respondent compliance. Babbie and Mouton (in Patel & Patel, 2019:34) argue that questionnaire arrangement influences response reliability and participation willingness. Following this perspective, initial questions were simplified and engaging to ease respondents into the survey. Open-ended questions were placed after closed-ended ones to maintain initial enthusiasm. Funnel sequencing was used, connecting each successive question to preceding ones. According to Nachmias and Nachmias (in Chivanga & Monyi, 2021:46), well-designed questionnaires should have broad questions before narrow ones. This approach improved respondents' information recall; starting with broad questions prevented imposing the researcher's frame of reference before understanding participants' perspectives.

The study's questionnaire consists of four sections: Section A explores socio-economic household aspects, Section B examines general farm data, Section C delves into small-scale farmers' climate change risk perceptions, and Section D investigates adaptive measures adopted by small-scale farmers and related concerns, identifying areas needing improvement.

A pre-survey pilot study involving eight Caluquembe Municipality household heads ensured questionnaire validity, accuracy, and consistency. This pilot phase included recruiting enumerators, interacting with key informants, and translating questions into Kimbundu, the local language. Participant discussions and feedback led to questionnaire adjustments, excluding pilot results from the final thesis.

3.7.2 Face-to-Face Key Informant Interviews (KIIs)

Face-to-face interviews were employed to acquire comprehensive insights and viewpoints from participants, including representatives from governmental organizations and NGOs engaged in regional climate change initiatives. The interviews delved into organizational roles concerning climate change interventions, perceived causes and solutions to climate change, vulnerability levels among various communes and groups, adaptation strategies among small-scale farmers, adaptation obstacles, and institutional support extended to farmers. Key objectives encompassed identifying gaps in understanding and overcoming local and national climate change challenges.

Semi-structured interviews aimed to gather diverse stakeholder perspectives on climate change interventions, enabling an all-encompassing analysis of pertinent issues. Ethical considerations allowed key informants to participate or decline interviews; three declined due to professional commitments, prompting replacements within the community. Interview scheduling involved participant consultation, with reminders for confirmation. Open-ended questions explored experiences, attitudes, beliefs, and perceptions of the research topic.

Interviews lasted 30 minutes to 2 hours, facilitating comprehensive climate change risk perception and adaptive measure adoption discussions. Revisiting certain key informants helped gather supplementary topic-related information. Tape recorders, used with participant consent, ensured accurate data capture. Face-to-face interviews afforded advantages, such as direct participant discussions to comprehend perspectives and cognitive transformations better. Ambiguous responses were clarified, and participants sought clarification on unclear questions. Despite being time-consuming with potential biases, face-to-face interviews outweighed limitations, complementing questionnaires and providing invaluable topic insights.

3.7.3 Focus group discussions (FGDs)

FGDs served as another data collection instrument, with three FGDs comprising six purposively chosen participants each, resulting in 18 participants. FGDs provided a platform for farmers in Caluquembe Municipality to express views and perceptions regarding climate change risk perception and adaptive measure adoption. These "group interviews" involve interactive discussions guided by the researcher (Willmott, 2020), focusing on farmers' climate change

perspectives and adaptation strategies. Before FGDs, consultative briefings occurred to discuss the study's objectives, relevant local matters, and discussion agendas. Engaging various stakeholders in these meetings reflects a participatory approach, which aids in uncovering local cultural, historical, socioeconomic, geographic, and political factors that influence community behavior and practices (Gaus, 2017). FGDs enabled collecting a wide range of information unattainable through household surveys or key informant interviews alone. Participants assisted one another in recalling study-related details.

FGDs centered on thematic areas such as climate change risk perception (causes and impacts), vulnerability, adaptation measures, and institutional and policy support for adaptation. While group dynamics can impact discussions, the moderator ensured balanced and inclusive participation, encouraging every participant to contribute perspectives without dominant opinions overshadowing others (Gaus, 2017). The moderator's role was crucial in maintaining discussion integrity, fostering diverse contributions, and preventing desirability influences, conformity pressures, or dominant group member persuasion from unduly influencing outcomes.

FGDs proved advantageous in terms of time efficiency, allowing for substantial data collection in a relatively brief period while maintaining cost-effectiveness. Though yielding less data than individual interviews with the same participant count, FGDs contributed to data triangulation in this study. The data gathered from FGDs complemented information obtained via questionnaires, key informant interviews, and observations. These discussions enabled exploration of farmers' overall perspectives and opinions regarding the connection between climate change risk perception and adaptive measure adoption.

3.7.4 Observation

Furthermore, a limited dataset was gathered via participant and field observations, with researchers taking field notes to document relevant details during or after site visits. Photographs were captured when farming locations and landscapes held significance, depicting geographic attributes, livelihoods, land use, and general landscapes. These images helped record factors such as land degradation and soil erosion, offering visual substantiation and illustrating the region's prevailing climate change vulnerability.

3.8 Data Presentation and Analysis Procedure

A comprehensive mixed-methods analysis combined qualitative and quantitative techniques to achieve a thorough understanding of the research subject. This involved contrasting findings from both data types, exploring convergences or divergences, and utilizing one data type to provide context for the other. The aim was to address research objectives and gain insights into smallholder farmers' risk perceptions and decision-making processes regarding climate change adaptive measures. Data analysis occurred in two stages (Teoh, 2019), with the first stage analyzing data during collection and the second analyzing data post-collection. Data from Caluquembe Municipality concerning climate change risk perception and adaptive measure adoption were analyzed using these stages. Analyzing data during collection allowed monitoring of research objectives and ensured adequate addressing of research questions (Teoh, 2019).

Preprocessing collected data according to a predetermined research plan is crucial (Singh, 2022). This study's data preprocessing included removing unused data, interpreting unclear answers, and verifying and rejecting contradictory data from related questions. For quantitative data, potential errors affecting data analysis were addressed. A coding system generated codes and scales based on responses, summarizing and analyzing them. Questionnaires with substantial missing data were excluded, while those with few missing items were coded for exclusion reasons. The researcher revisited the field to obtain missing information whenever feasible. SPSS software was utilized to code, tabulate, and analyze quantitative data. Cross-tabulation analysis explored the relationship between perceived climate risk (independent variable) and adopted adaptive methods (dependent variable) among small-scale farmers, investigating the connection between perceived climate risk and adaptation measure adoption.

For qualitative data, a content analysis was conducted. This involved establishing content categories and tallying the occurrence of relevant items within each category. The content analysis focused on analyzing the content of various documentary materials, such as books, magazines, discussions, and interviews. The researcher summarized the data in narrative form, interpreted the findings, and selected pertinent quotations to illustrate key ideas. This approach facilitated addressing the research problem and making constructive recommendations for potential policy implications.

Upon data analysis, a blend of statistical and graphical techniques was employed to communicate the results effectively. Bar graphs, pie charts, tables, and simple diagrams were employed to enhance clarity and precision for data users. The SPSS software was chosen for data analysis due to its proven effectiveness in this context. These visuals provided a clear understanding of any patterns or trends in the data, with a specific focus on identifying notable associations or trends between perceived climate risk and the adoption of specific adaptive methods.

3.9. Reliability and Validity

Achieving credible research outcomes necessitates emphasizing two fundamental research design aspects: validity and reliability (Dubey & Kothari, 2022). This study prioritized these factors to avoid obtaining inaccurate responses to the research question and objectives. By emphasizing validity and reliability, the study ensured the measurement tool's robustness and trustworthiness, bolstering confidence in the precision and consistency of research outcomes.

3.9.1. Reliability

Reliability of a research instrument is vital for consistent and trustworthy results. A reliable instrument ensures consistent measurements if the same data were collected again. However, reliability alone doesn't guarantee validity, which refers to the instrument's accuracy in measuring what it aims to measure (Singh, 2022). Testing an instrument's reliability involves considering data collection-related factors (Singh, 2022: 111), such as who collected the data, data sources, appropriate methods used, data collection timing, compiler biases, and desired accuracy level achievement. This study conducted a pilot study to ensure instrument reliability, serving as a test run for consistent and accurate data collection. A uniform data processing approach enabled alignment of conclusions with studies using similar methodologies. Multiple data collection methods, including questionnaires, interviews, and focus group discussions, enhanced reliability and credibility through data triangulation. This comprehensive approach aimed to bolster trustworthiness and accuracy of findings, allowing for cross-verification and validation of results.

3.9.2. Validity

Validity refers to how accurately the collected data represents the studied phenomenon (Teoh, 2019: 15), questioning whether the evidence confirms what it claims. Validity measures how well a research instrument tests or evaluates what it aims to (Ross & Call-Cummings, 2020). The connection between the measured concept and indicators is crucial (Carmines & Zeller via Willmott, 2020: 125), examining if the measurement captures the concept's intended meaning. Dodds & Hess (2020) state that validity concerns the truth or falsehood of research-generated propositions. A statement is valid when accurately measuring or describing what it claims. This study focused on enhancing validity by aligning research instruments with objectives. The questionnaire, the main data collection tool, was meticulously designed with Likert-type scales for some items. Simple language ensured clarity, and concise questions minimized ambiguity for better comprehension. Validity was strengthened by analyzing and testing data before, during, and after fieldwork, using multiple data collection methods, and subjecting research instruments to peer review and supervisor input. These measures aimed to strengthen the validity of findings, ensuring the instruments effectively measured their intended purposes within the study's context.

3.10 Ethical Considerations

Ethical considerations were diligently managed during the research, focusing on research presentation to potential participants, the impact of participation, outcomes of sampling strategies, and researcher engagement and dissemination sessions. The study adhered to Bindura University of Science Education's local practices, standards, rules, and regulations. The researcher's objectives were carefully considered when studying different cultures, communities, and ethnic groups, ensuring clear research objectives while prioritizing the welfare of involved individuals and/or groups. The following ethical guidelines were observed in the study:

3.10.1 Informed Consent: Participants were informed in writing about their voluntary participation and their right to withdraw at any time without penalty (Dzwigol, 2022). Research objectives, data collection methods, and expected participation levels were explained in a clear and understandable language.

3.10.2 Confidentiality: Private information shared by participants was managed by the researcher, ensuring no personal identification was linked to completed questionnaires (Burns & Grove via Dzwigol, 2022:57).

Participants were assured their information would be used solely for research purposes and available upon request. Completed questionnaire data was only used for generating frequencies and percentages, with no participant identification in the research report.

3.10.3 Anonymity: Collected information could not be linked to specific respondents, even by the researcher (Dodds & Hess, 2020). Neither participant nor institution names were required on the questionnaire. Despite the anonymity, completed questionnaires were securely stored with access limited to the researcher. Once the research report is finalized, all questionnaires will be destroyed.

3.10.4 Mitigating Participant Harm: Research can expose participants to social, psychological, economic, and physical risks (Greening, 2019). To minimize these potential harms, measures were implemented. Preventing personal information disclosure helped avoid stigma, discrimination, or prejudice, while addressing potential mental distress, such as stress, confusion, guilt, and low self-esteem, ensured participants' psychological wellbeing. Furthermore, ensuring participants' information disclosure did not harm employment, insurance, or academic status mitigated economic risks. Lastly, adopting precautions against potential harm during sensitive discussions contributed to physical safety. These measures aimed to create a secure environment for participants throughout the research process.

3.10.5 Benefits: The respondents were informed that they would not receive any remuneration for participating in the study.

3.10.6 Research Permission: The researcher obtained written consent from the relevant authorities to conduct the study in the targeted community.

3.11 Chapter Summary

In this chapter, an extensive examination of the research methodology employed in the study is provided, encompassing aspects such as the underlying research philosophy, design, geographical scope, participant demographics, data gathering techniques, and analytical procedures. The rationale behind selecting this methodology is elaborated upon, justifying the adoption of a mixed-methods approach that incorporates both qualitative and quantitative elements. Furthermore, a critical evaluation of the methodology's strengths and limitations is undertaken. The subsequent chapter delves into the data presentation, interpretation, and analysis, with the objective of extracting pertinent and insightful conclusions.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

In the previous chapter, a detailed examination of the research methodology used in this study was provided, covering various aspects such as the research philosophy, design, sample characteristics, data collection methods, and data analysis processes. This chapter focuses on presenting, analyzing, and discussing the findings derived from data collected on the connection between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola. The findings are presented in relation to the objectives outlined in Chapter One, with several themes explored, including smallholder farmers' perceptions of climate change risks, the adaptive measures they employ, and the relationship between perceived risk and the adoption of adaptive measures. Figures and tables have been included to provide a clear visual representation of the study's findings.

4.1 Response Rate

This research utilized four unique data collection techniques: key informant interviews, questionnaires, focus group discussions, and observation. Questionnaires were administered to participants, with a total of 100 distributed and an 80% response rate achieved from the 80 collected. Key informant interviews were conducted with two major groups: government officials and NGO representatives, with five interviews per group, offering valuable insights into climate risk perceptions and adaptive strategies among smallholder farmers in the study region. Furthermore, three focus group discussions, each with six participants, provided a platform to gather diverse viewpoints on the subject matter.

4.2 Social Demographic Characteristics of the Respondents

The study investigated the social demographic attributes of the participants, which included gender, age, household size, household position, educational background, marital status, and farm ownership particulars. These factors may impact decision-making and involvement in

farming development initiatives (Asravor, 2022). Key findings demonstrate a male majority among respondents (71.25%), with most aged between 41-50 years (51.3%). Most respondents were married (72.5%) and had completed primary school (63.75%). Household size assessment revealed that the majority of households (82.5%) consisted of 7-9 members. Such data provides important insights into the population's demographic structure, allowing policymakers to make informed decisions related to resource distribution, social services, and climate change adaptation strategies. The complete findings are presented in Table 4.1.

Table 4.1: Respondents Demographic Profile

Variable description	Categories	Frequency	Percent
Gender	Male	57	71.2
	Female	23	28.8
Age range	18yrs – 30yrs	9	11.2
	31yrs-40yrs	12	15.0
	41yrs-50yrs	41	51.2
	51yrs and above	18	22.5
Marital status	Married	58	72.5
	Single	2	2.5
	Widow	9	11.2
	Widower	3	3.8
	Divorced	8	10.0
Level of educational	No formal education	12	15.0
	Primary School	51	63.8

	Secondary Education	14	17.5
	Tertiary Education	3	3.8
Household size	Less than 4 members	6	7.5
	4-6 members	12	15.0
	7-9 members	48	60.0
	10 or more members	14	17.5
Farm ownership/ management	Yes	80	100.0
	No	0	0.0
Farm Size (in hectares)	Less than 1 ha	0	0.0
	1-5 ha	76	95.0
	Over 5 ha	4	5.0
Types of Farming Activities	Crop farming	0	0.0
	Livestock farming	0	0.0
	Mixed farming (both crops and livestock)	80	100.0
	Other (please specify)	0	0.0
Years of Farming Experience	Less than 5 years	0	0.0
	5 - 10 years	3	3.8
	Over 10 years	77	96.2

Source: Survey Data (2024)

4.3 Perceptions of Smallholder Farmers on Climate Change Risk

4.3.1 Level of Awareness of Climate Change and its Potential Risks

Respondents' awareness of climate change and associated risks to their agricultural activities was evaluated on a 1-5 scale. Figure 4.3 reveals that the majority (73.75%) considered themselves "Very aware," with an additional 13.75% identifying as "Extremely aware," signifying substantial awareness among participants about climate-related risks impacting their farming practices. Conversely, smaller percentages reported being "Moderately aware" (7.5%) or "Slightly aware" (5.0%) of climate change.

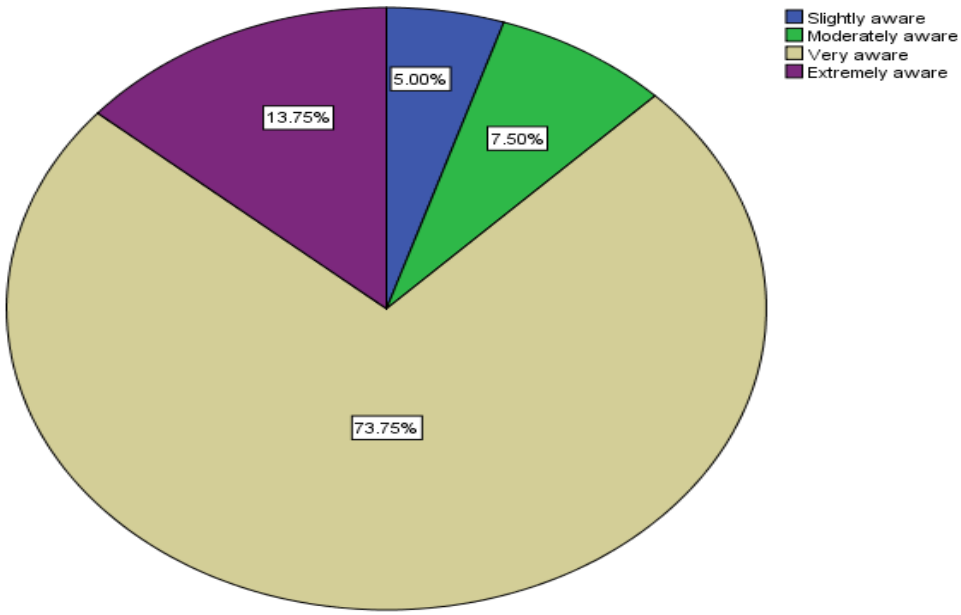

Figure 4.3: Level of Awareness of Climate Change and its Potential Risks

Source: Survey Data (2024)

The survey results indicate that farmers exhibit a substantial level of climate change awareness and its potential consequences for their agricultural activities. These survey outcomes were

further supported by participants' viewpoints during FGDs. One farmer underscored her comprehension of climate change and its risks in a passionate statement, asserting,

> *"I have seen firsthand how unpredictable weather patterns and hotter temperatures have wreaked havoc on our crops. It is like nature has gone off balance, and we have to constantly adapt to survive."*

This sentiment was echoed during the key informant interviews. A knowledgeable extension worker emphasized the participants' strong awareness and their eagerness to collaborate, stating,

> *"Farmers in this region are climate change warriors! They are not just aware; they are hungry for information and solutions. They are actively seeking out climate-smart practices and are determined to safeguard their agricultural activities for future generations."*

4.3.2 Perceived Threat Level of Climate Change to Livelihood

Respondents were requested to rate their perception of climate change's threat level to their livelihood on a 1-5 scale. As shown in Figure 4.4, three-quarters of the participants (75.0%) deemed climate change "Extremely threatening" to their livelihoods. An additional 16.25% perceived it as "Very threatening," with 7.5% considering it "Moderately threatening." A minor 1.25% viewed climate change as "Slightly threatening."

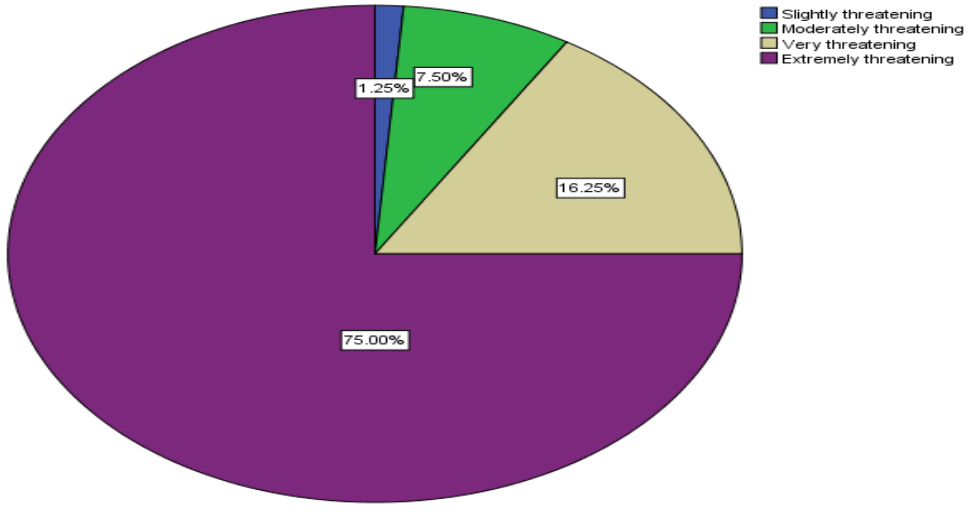

Figure 4.4: Perceived Threat Level of Climate Change to Livelihood

Source: Survey Data (2024)

FGDs and interviews with participants validated the substantial impact of climate change on their livelihoods. Participants expressed deep concern regarding climate change consequences during FGDs. One farmer, a widow, highlighted the severity of the issue, stating,

> *"Climate change has turned our lives upside down. Our crops are failing, and we struggle to feed our families. It feels like our very survival is at stake."*

This sentiment was also echoed during the key informant interviews. An NGO representative shared their observations, stating,

> *"Through our interactions with the community, it is evident that climate change is wreaking havoc on their livelihoods. We have witnessed firsthand the struggles they face, from crop losses to increased food insecurity. It's a pressing issue that requires immediate attention".*

4.3.3 Levels of Concern Regarding Climate-Related Risks

To assess their level of concern regarding climate change-related risks, respondents were surveyed on a diverse set of factors, such as temperature pattern alterations, storm and wind events, rainfall pattern shifts, water quality and availability, pest and disease occurrence, drought conditions, the drying of streams and underground water sources, snow and hailstorms, and productivity/yield changes. Participants could choose from five responses, ranging from "Extremely concerned" to "Not concerned at all," enabling them to communicate their worry level based on personal experiences and risk perceptions. The survey outcomes are depicted in Figure 4.5.

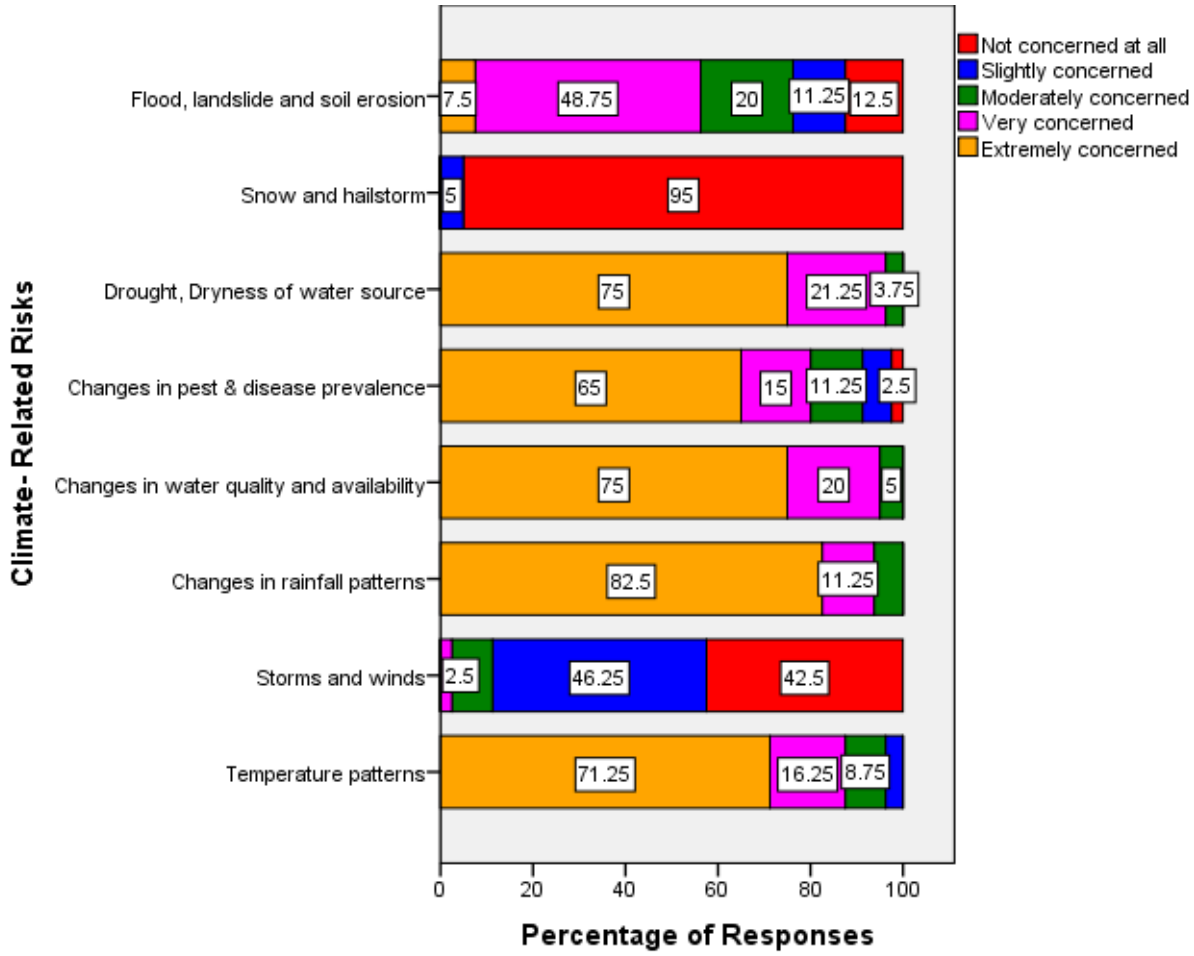

Figure 4.5: Levels of Concern Regarding Climate-Related Risks

Source: Survey Data (2024)

The survey results reveal respondents' varying degrees of concern about different climate change impacts. The majority expressed being "Extremely concerned" about changes in rainfall patterns (82.5%), temperature patterns (71.25%), water quality/availability (75%), and drought/dryness (75%). Respondents were also "Extremely" or "Very concerned" about changes in pest/disease prevalence (80%) and flood/landslide/erosion (56.25%). In contrast, fewer respondents were highly concerned about storms/winds, with only 8.75% being "Moderately concerned" and the rest indicating "Slight" or "No concern." Respondents demonstrated the least concern about snow/hailstorms, with 95% reporting they were "Not concerned at all.

In a field visit to a farm in Ngola commune, the researcher witnessed firsthand crops and trees exhibiting signs of dryness-induced stress (Figure 4.6), confirming the issue of arid conditions previously raised by respondents.

Figure 4.6: Visible Effects of Dry Conditions on Crops and Trees in Ngola Commune Farm.
Source: Author's own Observation (2024)

Additionally, another photo was taken during the field visit, capturing the aftermath of a recent flood in Calepe commune, as shown in Figure 4.7. This visual evidence corroborates respondents' concerns about flooding and soil erosion in the area.

Figure 4.7: Aftermath of Flooding in Calepe Commune
Source: Author's own Observation (2024)

Additional data gathered from FGDs and key informant interviews provided valuable insights that complement and reinforce the survey findings. In the FGD discussions, participants openly shared their concerns and perspectives regarding various climate-related risks. For instance, one participant expressed deep worry about the impact of changing rainfall patterns on agricultural productivity, stating,

> *"The direct effect of changing rainfall patterns on our agricultural productivity is a major concern. Erratic rainfall makes it extremely challenging to effectively plan and manage our crops."*

Likewise, participants expressed grave concerns about the escalating temperatures and the potential repercussions on vital resources such as water, crops, and livestock. A participant emphasized,

> *"We are deeply worried about the rising temperatures as they result in prolonged droughts and heatwaves. This not only affects our water sources but also poses a severe threat to the survival of our crops and livestock."*

Furthermore, key informant interviews, including those with government officials, provided additional valuable insights. A government official shed light on the intertwined challenges posed by rising temperatures and the proliferation of pests and diseases. They commented,

> *"The increasing temperatures exacerbate the prevalence of pests and diseases, presenting significant challenges to our agricultural sector. Farmers are grappling with the complexities of managing these changing dynamics, which have a detrimental impact on crop yields and overall productivity."*

These firsthand perspectives shared by the FGD participants and the insights provided by the key informants validate the concerns expressed in the survey.

4.3.4: Farmers' Perception of the Changes in Farming in Comparison to Previous Years.

The survey gathered data on eight farming-related parameters: Rainfall, Pests and diseases, Storms/winds, Drought/dryness of streams and underground water sources, Snow/hailstorm, Productivity/yields, Temperature, and Floods/Landslide/soil erosion. Respondents selected one option per parameter based on personal observations in comparison to previous years. Figure 4.8 showcases the survey findings, revealing shifts in these parameters over time.

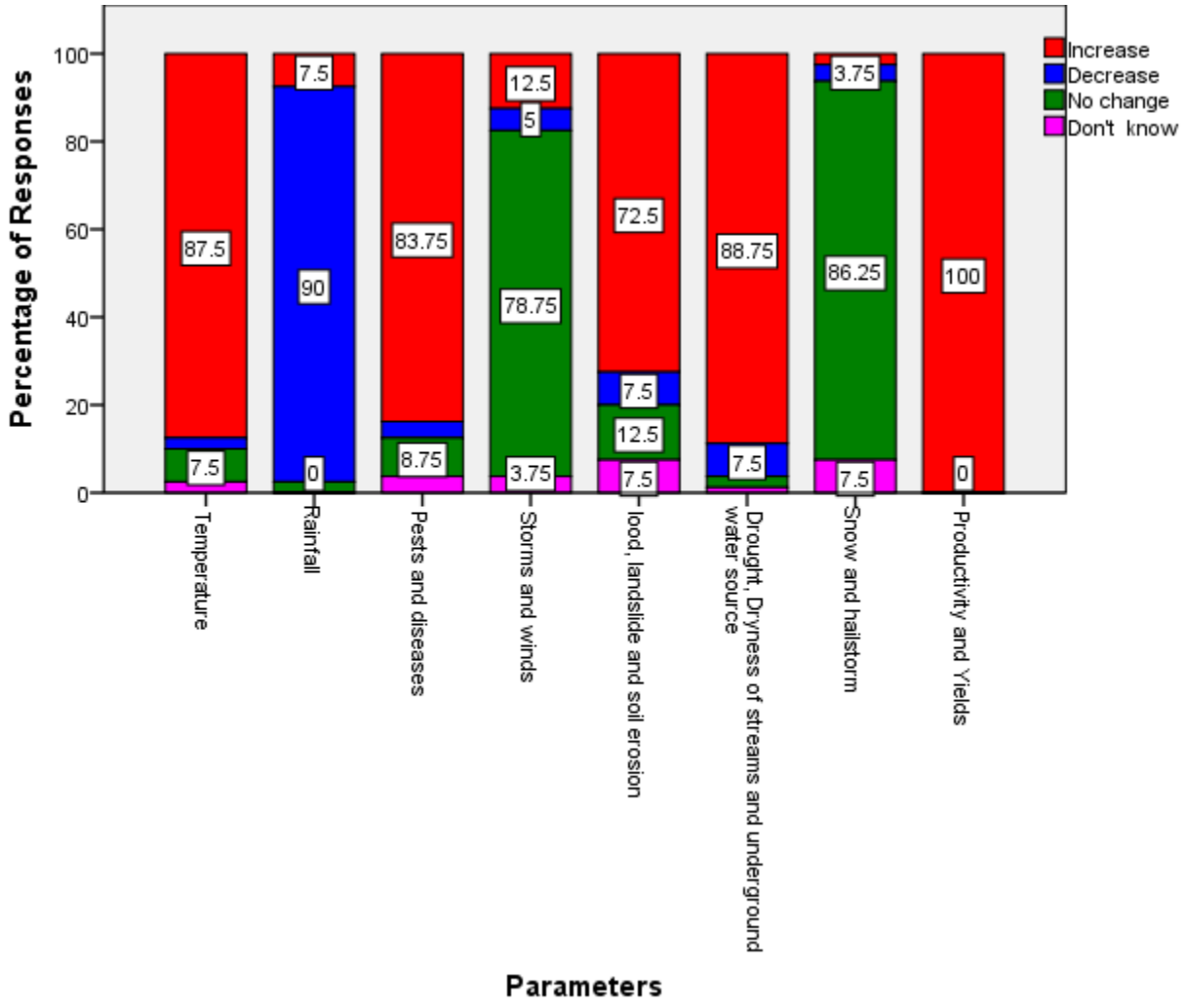

Figure 4.8: Farmers' Perception of the Changes in Farming in Comparison to Previous Years.
Source: Survey Data (2024)

An examination of Figure 4.8 highlights diverse alterations in various environmental parameters, as perceived by respondents. Regarding temperature, most (87.5%) observed a rise, while a significant 90% reported a decline in rainfall. Pests and diseases also showed an uptick for 83.8% of participants. Similarly, 72.5% noted an increase in flood, landslide, and soil erosion incidents. Notably, 88.8% reported a surge in drought and the drying of streams and underground water sources. In contrast, storms and winds demonstrated no considerable shifts, as indicated by 78.8% of respondents. All respondents (100%) discerned a reduction in productivity and yields

compared to past years. Finally, snowfall and hailstorms were the only parameters with no perceived change by the majority (86.2%).

4.3.5: Farmers' perception of rainfall patterns in comparison to previous years.

To understand changes in rainfall patterns compared to previous years, the survey queried farmers on aspects such as monsoon onset/retreat, untimely rainfall, number of rainy days, and rainfall intensity/frequency. Figure 4.9 demonstrates that most respondents (47.5%) reported a reduction in rainy days. Moreover, 31.25% noticed shifts in monsoon timing, 16.25% experienced an increase in untimely rainfall, and 5% pointed out changes in intensity/frequency.

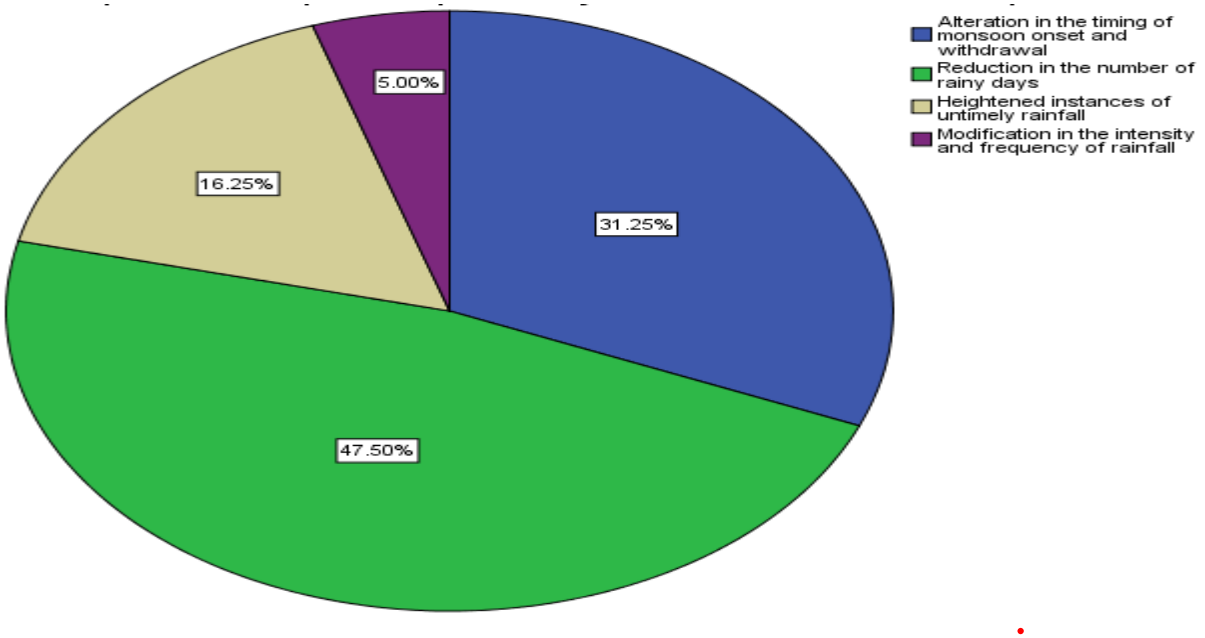

Figure 4.9: Farmers' perception of rainfall patterns in comparison to previous years.
Source: Survey Data (2024)

4.3.6: Variations in Temperature Patterns Over Past Years

Figure 4.10 showcases respondents' observations of temperature pattern alterations compared to past years, emphasizing warmth during summer, frequency of hot and cold days, and winter chill. Understanding these perceptions is crucial for informing future adaptation strategies, given

the significance of temperature patterns as a key indicator of climate change (Steenkamp & Thebuho, 2022).

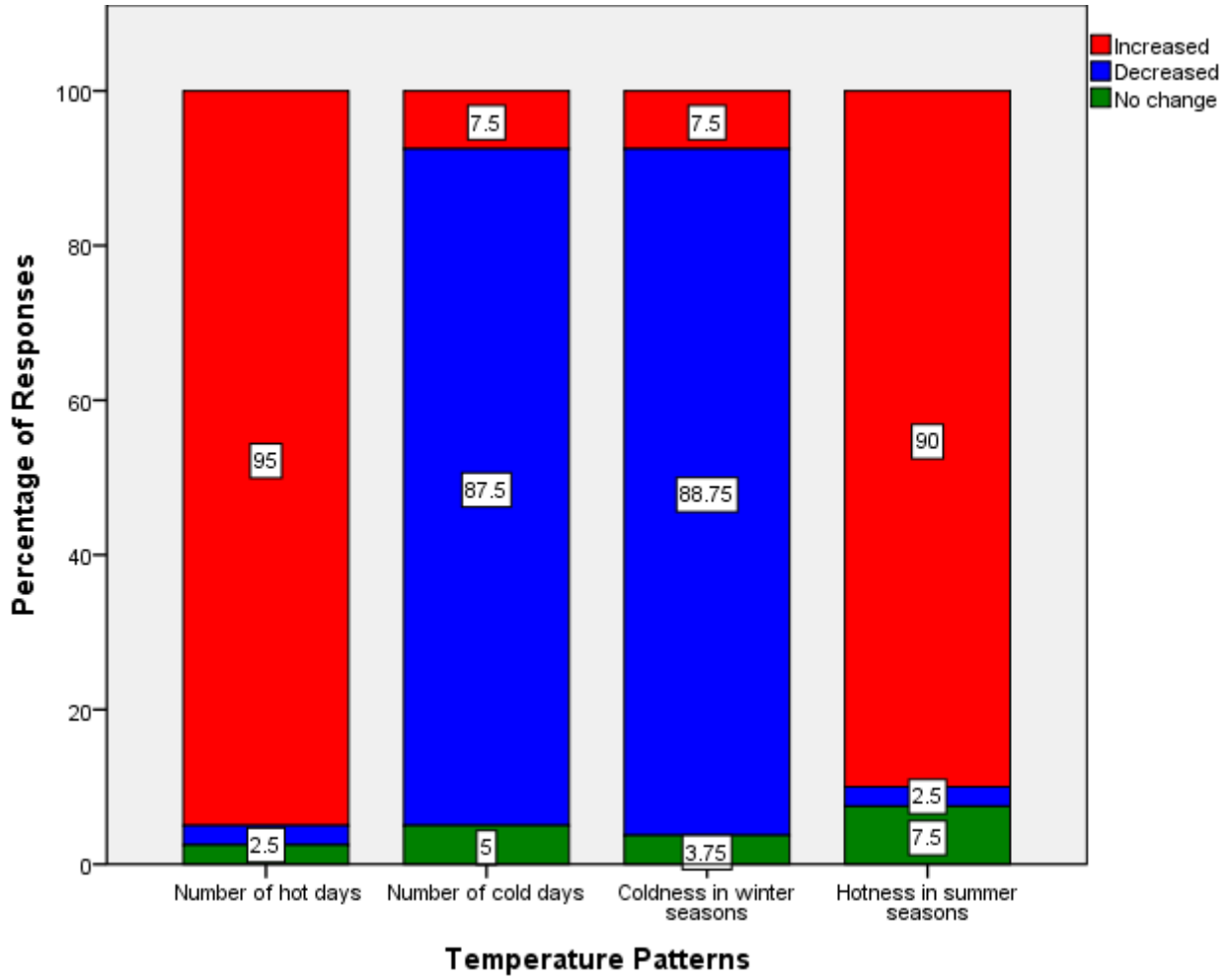

Figure 4.10: Variations in Temperature Patterns Over Past Years

Source: Survey Data (2024)

Figure 4.10 reveals that most respondents observed rises in summer warmth (90%) and frequency of hot days (95%), alongside reductions in cold days (87.5%) and winter chill (88.75%). In contrast, minimal percentages reported no shifts or declines in these temperature parameters compared to previous years.

4.3.7: Impacts

4.3.7.1: Varied Impacts of Climate Change on Different Aspects of Smallholder Farmers

As shown in Figure 4.11, the majority of respondents reported significant or medium impacts of climate change across key domains. Most saw significant impacts on income/food security (70%), crop yields (68.75%), water quality (65%), and water availability (60%). Impacts on soil fertility, pests/diseases, and livestock were mostly medium. Market/input disruptions had more varied responses, with over half reporting medium impact.These outcomes clearly illustrate that smallholder farmers are grappling with extensive and diverse repercussions of climate change.

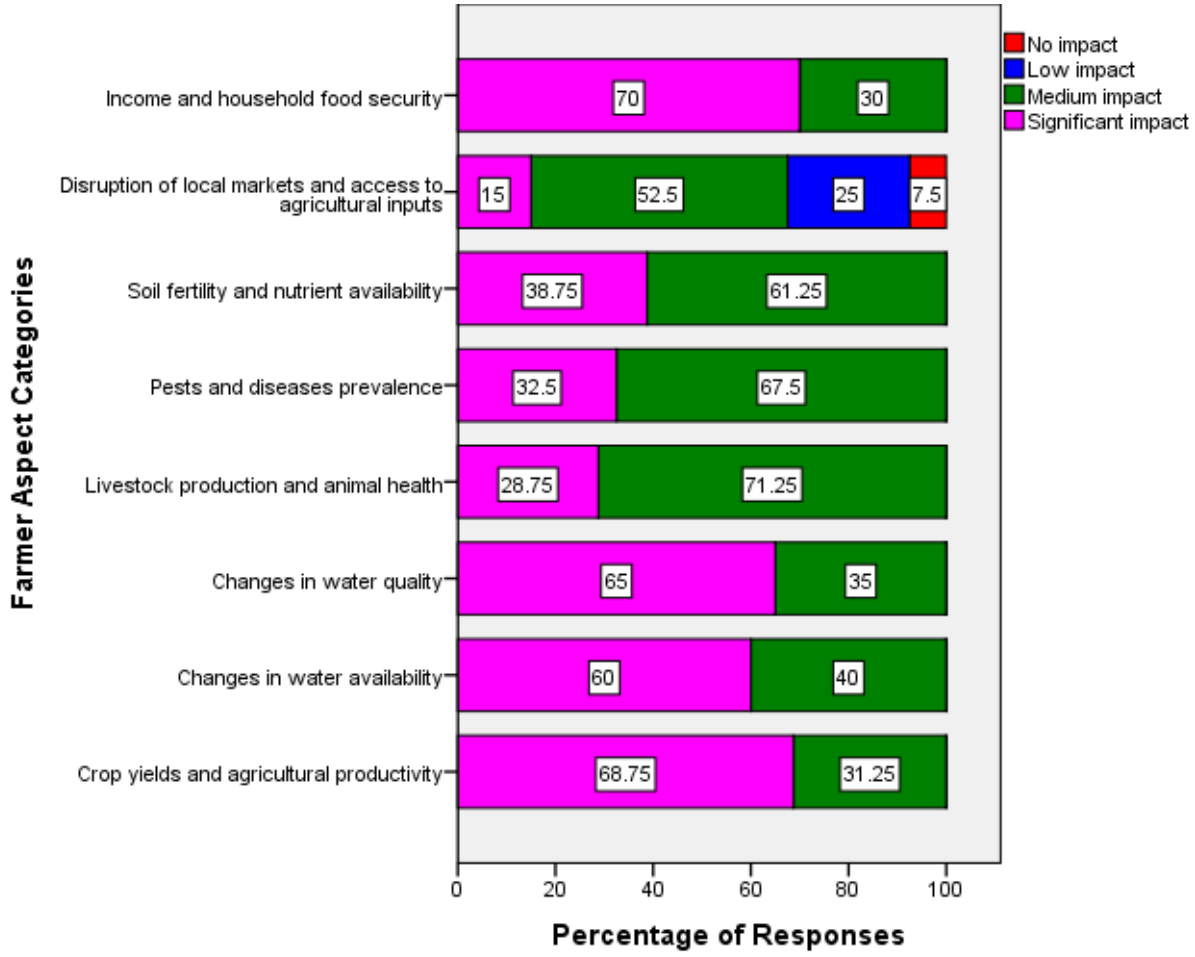

Figure 4.11: Varied Impacts of Climate Change on Different Aspects of Smallholder Farmers

Source: Survey Data (2024)

Findings from FGDs and key informant interviews further emphasized the extensive ramifications of climate change on smallholder farmers. Participant testimonies offered insights into the issues these farmers face concerning food security, crop production, and water accessibility and quality. One farmer, in the course of FGDs, expressed distress about the significant repercussions of climate change on agricultural yield, asserting,

> *"Climate change has wreaked havoc on our agricultural productivity. Erratic weather patterns and prolonged droughts have severely affected our crop yields. It's becoming increasingly difficult to provide enough food for our families and meet market demands".*

This sentiment was further supported by a key informant, an extension worker, who observed,

> *"The impacts of climate change on food security and crop yields are evident across the region. Farmers are struggling to adapt to changing weather conditions, with rising temperatures and unpredictable rainfall patterns. This has resulted in decreased crop productivity and increased vulnerability to food insecurity".*

In terms of water availability and quality, participants in the FGDs also highlighted the disruptive effects of climate change. One participant stated,

> *"Climate change has disrupted our water sources. We are experiencing more frequent and prolonged dry spells, leading to water scarcity for irrigation and household needs. Moreover, the quality of available water is deteriorating, making it challenging to sustain our agricultural activities".*

Another participant echoed this concern, highlighting the dire consequences on crop yields and the broader agricultural productivity,

> *"Water scarcity has emerged as a pressing issue for us farmers. With the shifting rainfall patterns, the availability of water for irrigation has significantly dwindled. This alarming situation has dealt a severe blow to our crop yields, pushing us towards a state of distress and jeopardizing the overall productivity of our agricultural endeavors.*"

4.3.7.2: Magnitude of Impact of Each Parameter on Farming

Respondents evaluated climate change's effects on agriculture through seven parameters: rainfall, temperature, storms and winds, snow and hailstorms, pest and disease occurrence, drought and the drying of streams and underground water sources, as well as floods, landslides, and soil erosion. Participants selected an impact category for each parameter: significant, medium, low, or none. Figure 4.12 outlines the climate change factors and their respective influences on farming practices and livelihoods within the study region.

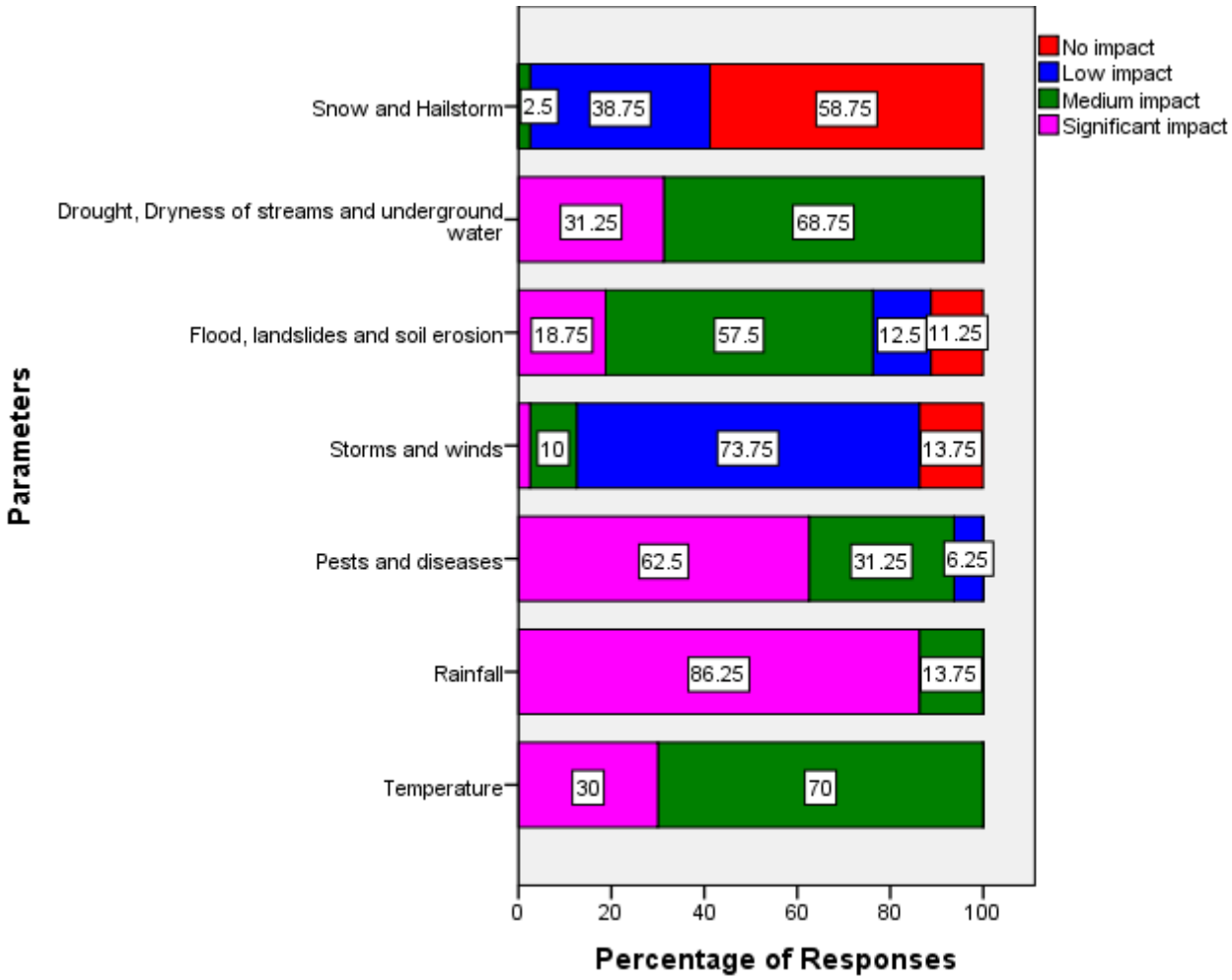

Figure 4.12: Magnitude of Impact of Climatic Risk Factors on Farming

Source: Survey Data (2024)

According to Figure 4.12, the majority of respondents perceived rainfall (86.25%) and pests/diseases (62.5%) as having a significant impact on farming. Temperature (70%), floods/landslides/erosion (57.5%), and drought/dryness (68.75%) were mostly seen as having a medium impact. Storms/winds (73.75%) and snow/hail (58.75%) were viewed as having low or no impact. No respondents selected low or no impact for rainfall or drought/dryness.

4.3.7.3: Major Impact Felt by Farmers on Farming

Participants ranked the parameters they believed had the most significant influence on agriculture, including rainfall, pest and disease incidence, temperature, drought and drying of water sources, storms and winds, snow and hailstorms, as well as floods, landslides, and soil erosion. As shown in Table 4.2, most respondents (47.5%) recognized rainfall as the most impactful factor on farming. Pest and disease occurrence ranked second (16.3%), followed by temperature (12.5%), drought and dryness (11.3%), floods, landslides, and erosion (6.3%), storms and winds (3.8%), and finally, snow and hailstorms (2.5%).

Table 4.2: Most Significant Climate-Related Impact on Farming

		Frequency	Percent
Valid	Temperature	10	12.5
	Rainfall	38	47.5
	Pests and diseases	13	16.3
	Storms and winds	3	3.8
	Flood, landslides and soil erosion	5	6.3
	Drought, dryness of streams and underground water	9	11.3
	Snow and hailstorm	2	2.5
	Total	80	100.0

Source: Survey Data (2024)

Insights gathered from FGDs and key informant interviews with both NGO and government officials provided additional validation to the claim that rainfall was the primary factor impacting farming. For example, during one FGD session, a farmer consistently emphasized the crucial role of rainfall in determining crop success. She remarked,

> "*Without adequate rainfall, our crops suffer and our yields are significantly reduced. It is clear that rainfall is the lifeline of our farming operations."*

This sentiment was echoed by another farmer who noted,

> *"In my experience, rainfall patterns have become increasingly unpredictable, leading to inconsistent crop growth. When rains fail or become erratic, it seriously affects our farming outcomes."*

The FGDs also provided a platform for farmers to share their first-hand experiences and perspectives. One participant passionately described the impact of rainfall on farming, stating,

> *"We have witnessed firsthand how variations in rainfall directly affect our agricultural productivity. There have been instances of prolonged dry spells that parch our fields and hinder crop growth, as well as sudden heavy rainfall that leads to waterlogging and soil erosion, damaging our crops. These erratic weather patterns make it challenging for us to plan for successful harvests."*

Similarly, in the key informant interviews conducted with government officials, it became evident that rainfall variability was a pressing concern for farmers in the region. An official stated,

> *"Farmers heavily rely on rainfall for their farming activities, and any deviations from the normal rainfall patterns can have severe consequences. We have observed instances of prolonged droughts and unexpected heavy rainfall, both of which pose significant challenges to crop cultivation and agricultural productivity."*

Similar sentiments were also expressed by an NGO representative who had this to say,

"Our organization has been closely working with farmers in this region, and it is evident that changes in rainfall patterns have a profound impact on their livelihoods. We have witnessed firsthand the struggles farmers face when rainfall becomes insufficient or erratic. It affects their ability to plan, invest, and secure their harvests."

The insights obtained from both the FGDs and key informant interviews align in emphasizing the paramount importance of rainfall in shaping farming outcomes.

4.3.8: Impacts with Potential to Become a Major Problem in the Future

Participants were prompted to anticipate a significant issue arising from the discussed impacts, selecting from five options: poverty escalation, food insecurity, conflicts over land and water resources, heightened migration, and threats to social and cultural well-being. Figure 4.13 indicates that most respondents (46.25%) predicted conflicts over resources as the most significant concern. Food insecurity followed closely (28.75%), with increased migration (12.5%) and poverty (11.25%) trailing behind. Only 1.25% perceived social and cultural well-being threats as a likely major issue.

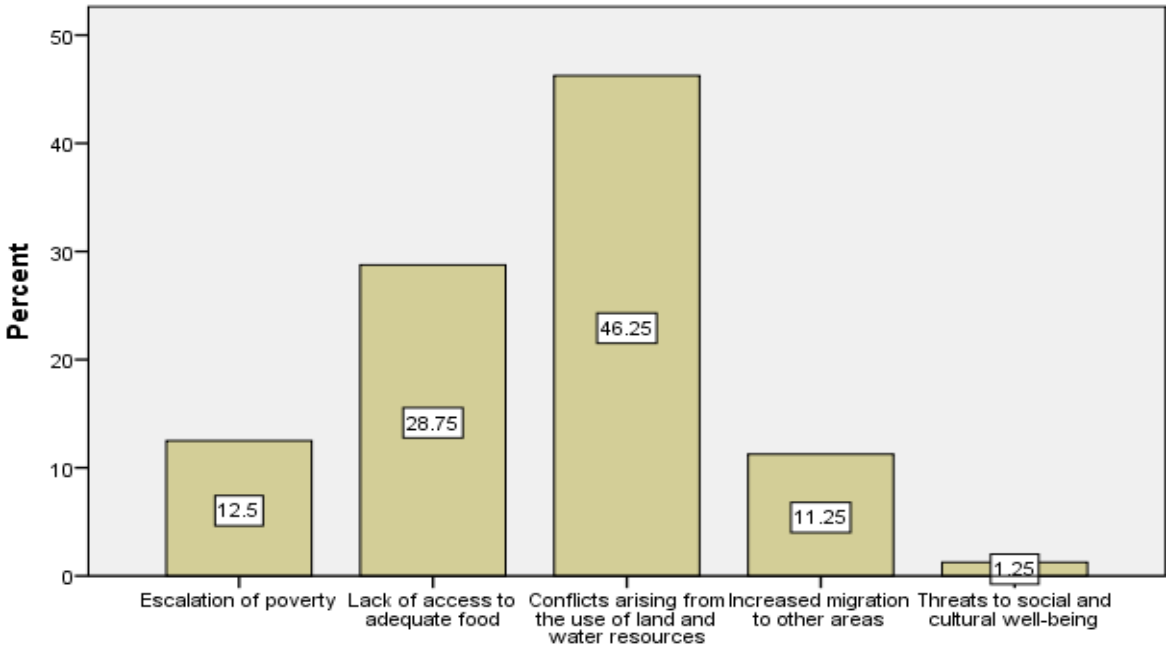

Figure 4.13: Impacts with Potential to Become a Major Problem in the Future

Source: Survey Data (2024)

The survey findings on potential future conflicts over land and water resources were reinforced by FGDs and key informant interviews. FGD participants echoed concerns regarding resource scarcity and potential conflicts. A participant voiced their worries, stating,

> *"In our community, water scarcity is already becoming a serious issue. With climate change worsening, I can only imagine the conflicts that will arise over access to water resources in the future."*

Key informants, who possess in-depth knowledge of the local conditions, also echoed the survey findings. One key informant remarked,

> "*Water disputes are already a common occurrence here. As the effects of climate change intensify, such conflicts are likely to escalate, leading to social unrest and economic instability."*

4.3.9: Factors Influencing Farmers' Perception of Risks Associated with Climate Change

Identifying factors shaping smallholder farmers' climate risk perceptions is critical for assessing their information sources (Tofu et al, 2022). This study surveyed farmers to pinpoint these influential factors. Figure 4.14 reveals that social networks (56.25%) and personal experiences (36.25%) were the primary factors shaping climate risk perceptions among smallholder farmers, greatly outweighing media and other factors (3.75% each). These findings emphasize the pivotal role of social and experiential influences in shaping these farmers' understanding of climate-related risks.

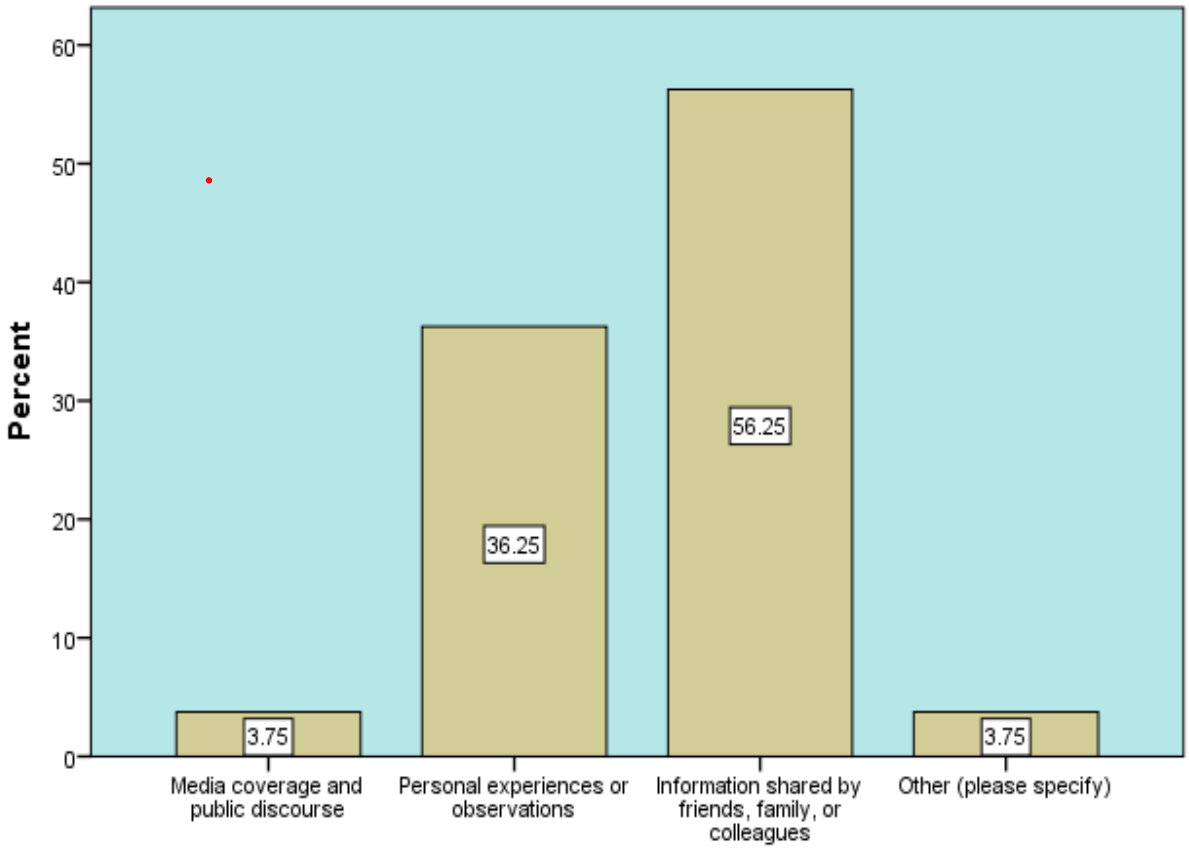

Figure 4.14: Factors Influencing Farmers' Perception of Risks Associated with Climate Change

Source: Survey Data (2024)

The survey results on the importance of interpersonal communication and personal experiences were further substantiated by insights gathered through FGDs, providing robust support to the findings. For example, during the FGDs, one participant expressed,

> *"Personal experiences play a significant role in shaping our perception of climate change risks. As farmers, we have witnessed extreme weather events such as prolonged droughts and unpredictable rainfall patterns, which directly affect our agricultural practices and livelihoods."*

Another participant emphasized the importance of interpersonal communication, stating,

*"In our tight-knit farming community, we rely heavily on exchanging information with fellow farmers, family members, and trusted colleagues. We learn from each other's experiences and adapt our farming techniques based on the knowledge shared within our networ*k."

4.4 Adaptation Measures

4.4.1 Adaptation Measures Being Practiced by Farmers

In order to examine the existing adaptation strategies utilized by farmers in the study region, an open-ended question was asked about the methods they employ to maintain their farming and livelihoods in the face of climate change. The findings are presented in Table 4.3.

Table 4.3: Adaptation Measures Being Practiced by Farmers

		Frequency	Percent
Valid	Changed crop selection or rotation	5	6.3
	Implemented water conservation measures	10	12.5
	Installed or upgraded irrigation systems	6	7.5
	Modified planting or harvesting schedules	40	50.0
	Implemented soil conservation practices	1	1.3
	Strengthening early warning systems for extreme weather events	3	3.8
	Utilized alternative pest and disease management strategies	6	7.5

	Adopted agroforestry or windbreak practices	1	1.3
	Utilized cover crops/ shade structures/mulching	2	2.5
	Promoting farmer-to-farmer knowledge exchange and learning	3	3.8
	Have done nothing	3	3.8
	Total	80	100.0

Source: Survey Data (2024)

As shown in Table 4.3, most respondents (50%) reported adapting their planting or harvesting timelines. This shift is a direct response to altered rainfall patterns and fewer rainy days in the area. A farmer elaborated on this during FGDs, sharing,

> *"We have had to adjust our planting and harvesting schedules due to the changing rainfall patterns. We now plant our crops late to take advantage of the late limited rainy days we have."*

Another respondent, a disabled farmer, mentioned that they shifted the planting of crops from September/October to January due to delayed rains. She explained,

> *As a farmer with a disability, I have to plan my farming activities carefully. The delayed rains in September/October made it difficult for me to cultivate my crops, so I shifted the planting season to January when the rains are more reliable.*

Approximately 12.5% of respondents shared they adopted water conservation strategies to tackle climate risks. Facing unpredictable rainfall, farmers devised methods for capturing and preserving water. Given that all respondents depended on natural rainfall or finite underground water sources, which were frequently shared for multiple communal uses, addressing inconsistent water availability became a priority. A farmer detailed their solution, explaining,

"We have constructed small ponds to collect rainwater and built concrete channels to direct the water to our farmlands. This way, we can conserve as much water as possible and use it efficiently for irrigation."

A portion of the respondents (7.5%) focused on managing their irrigation systems to ensure a year-round water supply. Additionally, another 7.5% utilized alternative strategies for pest and disease management. In an FGD, a farmer shared how her son, residing in the capital city of Luanda, had purchased basic irrigation facilities that enabled them to irrigate crops whenever their borehole had water. She stated,

"My son's investment in irrigation has been a game-changer for our farming. Even during dry spells, we can still provide water to our crops and ensure their survival."

Regarding pest and disease management practices, one farmer explained,

"We combine traditional methods, such as crop rotation and companion planting, with modern approaches like using organic pesticides. This integrated approach helps us control pests and diseases effectively while minimizing the use of harmful chemicals."

An extension worker during a key informant interview also emphasized the importance of combining traditional and modern approaches, stating,

"Farmers in this area have been successful in managing pests and diseases by integrating traditional knowledge with modern agricultural practices. This approach not only improves crop health but also reduces the environmental impact of chemical pesticides."

Some respondents (6.3%) reported changing their crop selection or rotation patterns. For instance, one farmer described shifting from maize to resilient small grains that could withstand hot and dry climatic conditions. He elaborated on the effectiveness of drought-resistant crops, stating,

"We have shifted from maize to small grains that are more resilient to the hot and dry climate in our area. These crops require less water and can withstand prolonged periods of drought, ensuring a more reliable harvest."

Furthermore, respondents mentioned engaging in various other adaptation measures. These included promoting farmer-to-farmer knowledge exchange and learning (3.8%), strengthening early warning systems for extreme weather events (3.8%), and, in some cases, adopting cover crops or mulching (2.5%), implementing soil conservation practices (1.3%), and adopting agroforestry or windbreak practices (1.3%). However, a small percentage (3.8%) indicated that they had not undertaken any specific adaptation measures.

4.4.2 Factors Influencing Farmers' Choice of Adaptation Measures

This research aimed to uncover the factors impacting farmers' choices about adopting particular adaptation strategies. Participants rated the influence of various factors such as resource accessibility, information and knowledge, technical assistance, training programs, awareness of climate risks and impacts, evidence of improved resilience, demand for climate-resilient products, regulatory compliance, long-term sustainability concerns, and traditional practices. Figure 4.15 illustrates the survey outcomes.

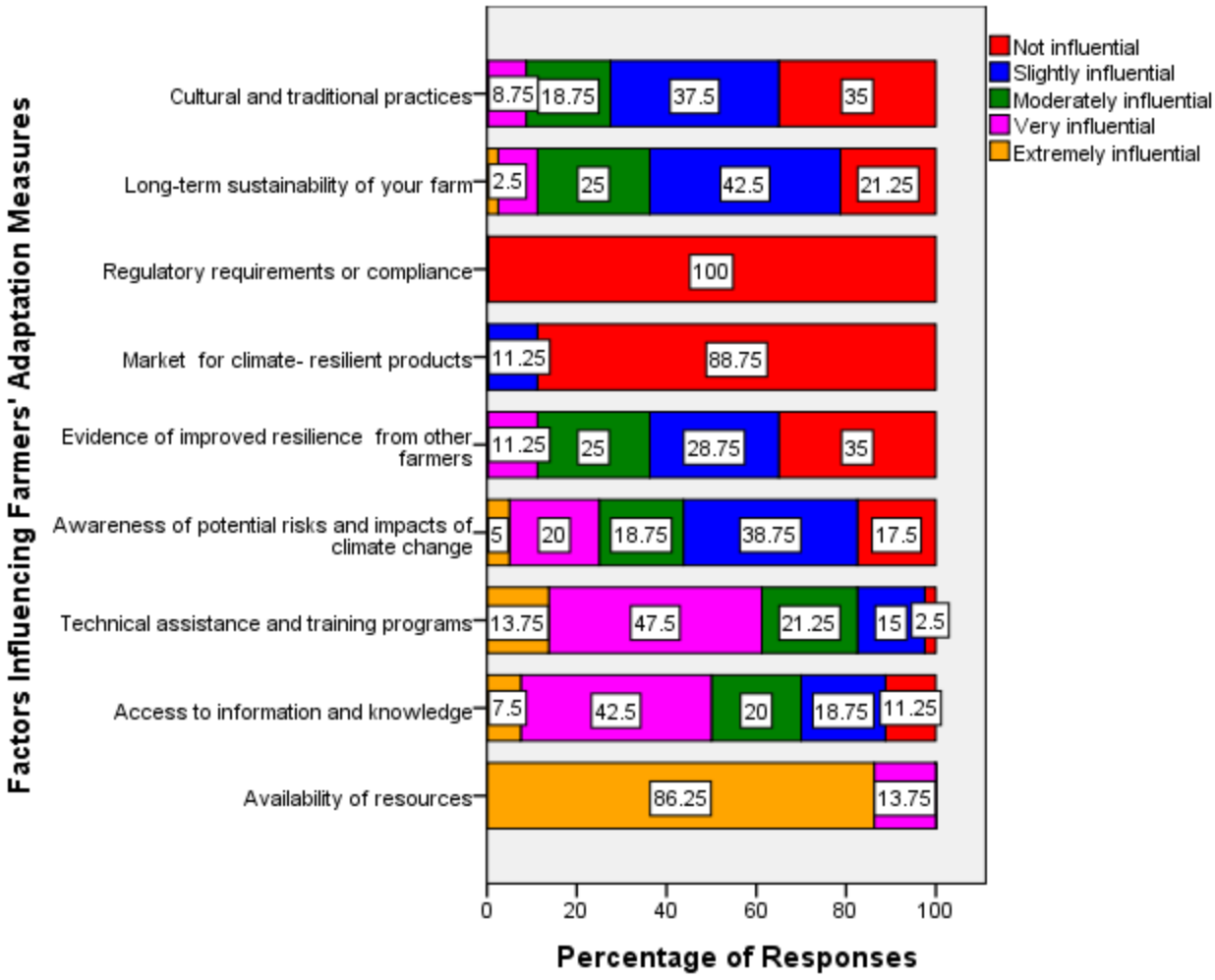

Figure 4.15: Factors Influencing Farmers' Choice of Adaptation Measures

Source: Survey Data (2024)

Analysis of the data in Figure 4.15 reveals that different factors have varying degrees of influence on farmers' choices of adaptation measures. Resource availability emerged as the most influential factor, with 86.25% of respondents rating it as "Extremely influential" and the remaining 13.75% rating it as "Very influential." During FGDs, participants openly expressed their concerns and perspectives on the influence of resource availability. One participant, who appeared to be the oldest among the respondents, expressed deep worry about resource availability, stating,

"I am deeply concerned about the availability of resources... It is becoming increasingly difficult to secure the necessary farming inputs to adapt to climate change... I cannot afford the heat-resistant seeds that grow better in this area."

During key informant interviews, representatives from NGOs and government recognized the significance of resources in adapting to climate change. A government representative remarked,

"Resources are a significant factor in farmers' decisions to adopt adaptation measures in this area... Limited access to resources like climate-resilient facilities hinders their ability to implement effective strategies... It is a challenge that needs to be addressed urgently."

Similarly, an NGO official echoed these sentiments, saying,

"Based on our experience working with farmers, we have observed that resource availability greatly influences their choices... Lack of resources limits their options and potential for successful adaptation... It is a critical issue that needs attention. Many farmers cannot afford the smart climate facilities."

Regarding other factors, access to information and knowledge was influential, with 42.5% rating it as "Very influential." Similarly, access to technical assistance and training was deemed "Very influential" by 47.5% of respondents. Awareness of climate change risks and impacts was considered "Slightly influential" by 38.75% of farmers. Evidence of improved resilience and productivity from other farmers was perceived as "Not influential" by 35%, while concern for long-term farm sustainability was seen as "Slightly influential" by 42.5%. Cultural and traditional practices were deemed "Slightly influential" by 37.5%, while market demand for climate-resilient products and regulatory requirements were largely viewed as "Not influential" by the majority of respondents.

4.4.3: Changes in Farming Practices Compared to Past Years

The survey's objective was to evaluate shifts in farming techniques compared to previous years and gauge the level of adaptation to climate change among farmers. Participants responded to seven questions concerning various farming practices with "yes" or "no" options. Figure 4.16 showcases the survey findings.

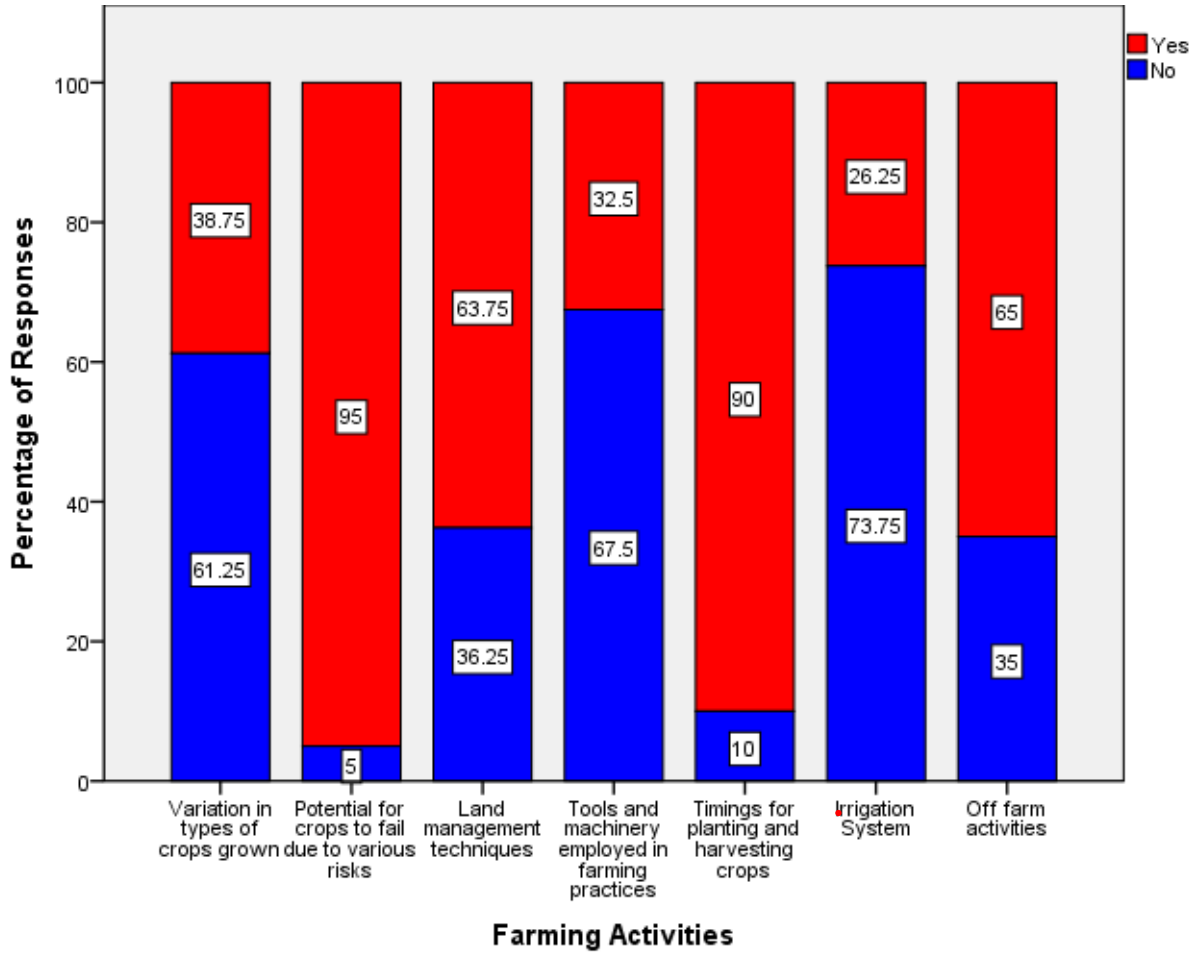

Figure 4.16: Changes in Farming Practices Compared to Past Years

Source: Survey Data (2024)

The survey found that 95% of farmers reported increased potential for crop failure due to climate risks, while 90% acknowledged changes in planting and harvesting timelines. 65% observed an increase in off-farm activities, indicating income diversification. Regarding land management, 63.75% reported adopting new techniques. However, only 38.75% noted changes in crop varieties, and 32.5% adopted new tools/equipment. 26.25% modified their irrigation systems.

4.4.4: Frequency of Seeking Climate Adaptation Information

To determine how often respondents sought information on adaptive measures for managing climate risks within the study region, participants chose from five frequency categories:

Monthly, Rarely, Weekly, Daily, and Never. Figure 4.17 displays the frequency at which respondents pursue information about such measures.

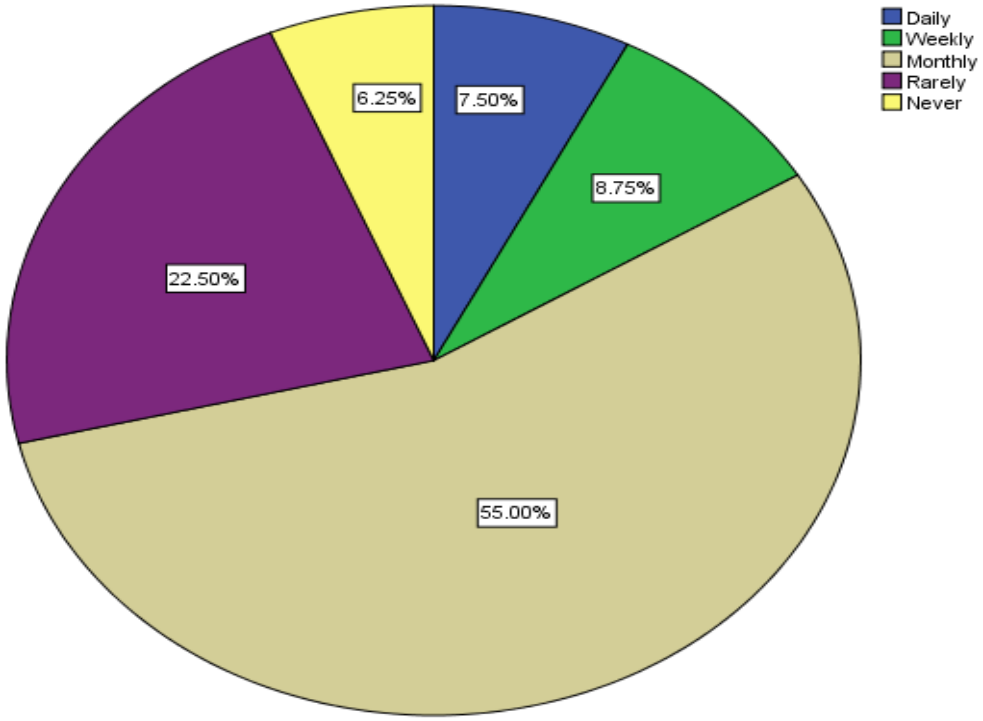

Figure 4.17: Frequency of Seeking Climate Adaptation Information

Source: Survey Data (2024)

The survey revealed that most respondents sought information on adaptation measures at varying intervals: 55% sought information monthly, indicating regular engagement; 22.5% sought information rarely; 8.75% sought information weekly; and 7.5% sought information daily. However, 6.25% reported never seeking such information.

4.4.5: Level of Barriers Towards Adaptations

In order to identify obstacles that impede farmers' adoption of adaptation strategies, respondents assessed the severity of seven barriers using a Likert scale of 1-5. A rating of 1 denoted a minor obstacle, while 5 indicated a highly significant barrier. Figure 4.18 showcases the findings.

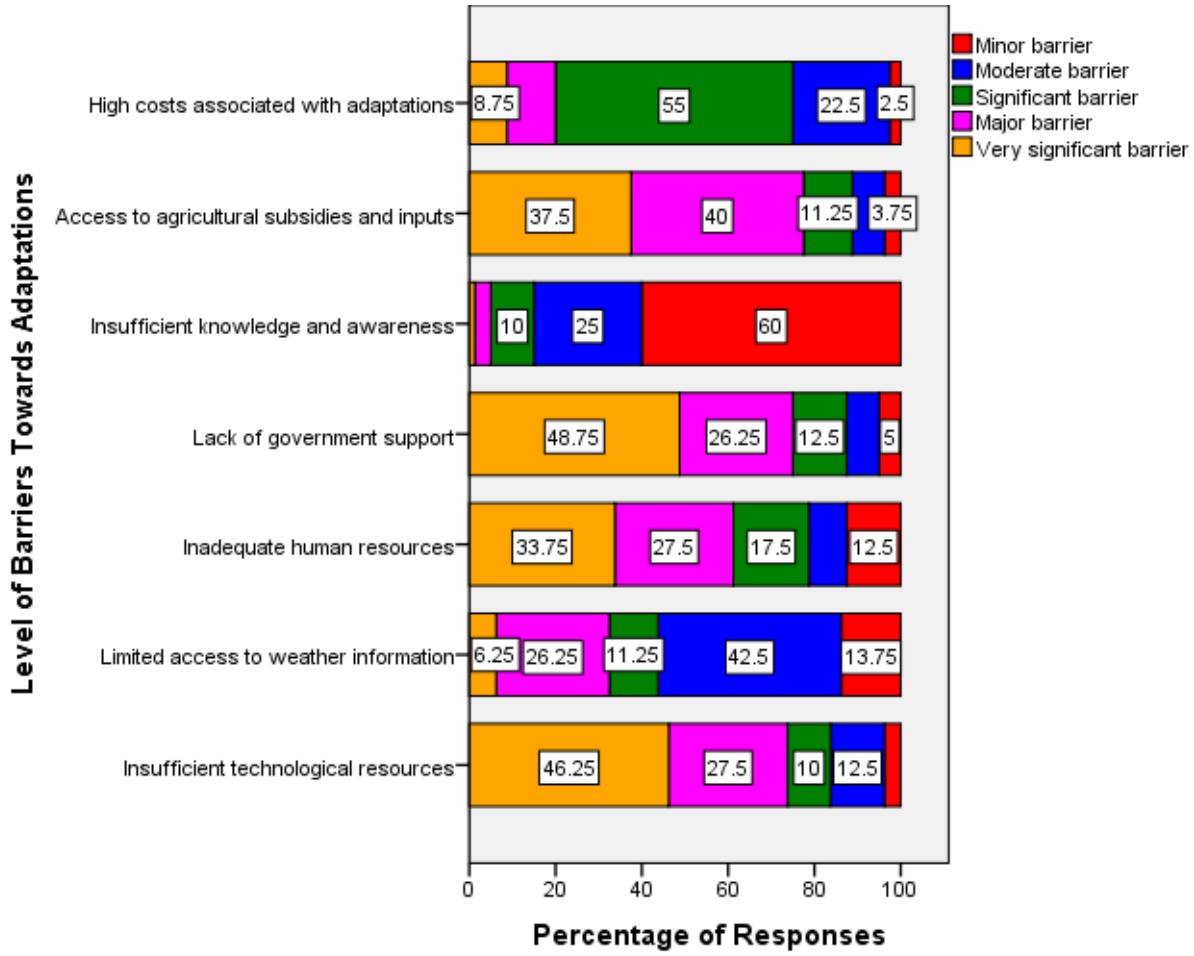

Figure 4.18: Level of Barriers Towards Adaptations

Source: Survey Data (2024)

A substantial proportion of respondents (46.25%) identified inadequate technological resources as a considerable hurdle, with 27.5% perceiving it as a significant impediment, 10% regarding it as a notable challenge, 12.5% considering it a moderate difficulty, and 3.75% viewing it as a minor complication. Effective agricultural adaptation strategies require technological resources, although their application is influenced by elements such as cost, practicality, and the technology type. FGDs echoed this concern, as a participant articulated their experience, saying,

> *"We do not have access to modern farming equipment in this area. It is a major barrier for us. Without advanced technology, it is hard to cope with the changing climate. We need better tools."*

Limited access to weather information was rated as a moderate barrier by the majority (42.5%) of respondents. Additionally, 26.25% rated it as a major barrier, 13.75% as a minor barrier, 11.25% as a significant barrier, and 6.25% as a very significant barrier. Farmers in the study area rely on regional weather forecasts from TV or radio, which may not accurately reflect local weather conditions. They lack access to local weather information through hardware or software innovations.

Inadequate human resources showed a different pattern, with the majority (33.75%) rating it as a very significant barrier. Additionally, 27.5% rated it as a major barrier, 17.5% as a significant barrier, 12.5% as a minor barrier, and 8.75% as a moderate barrier. One reason for this barrier is rural-urban migration, which leads to a lack of available human resources for farming. This was emphasized by respondents who participated in FGDs. For example, one respondent, an elderly female farmer, remarked,

> *"Most of the young people have left the village for better opportunities. We are short of labor. I am getting older, and it's challenging to manage the farm. As you can see, I rely on these two workers alone, and the land is too big for them. All my children and grandchildren stay in Luanda where there are better opportunities."*

Lack of government support emerged as the most significant barrier, with 48.75% of respondents rating it as a very significant barrier. This observation was reinforced by both participants from FGDs and key informant interviews. During FGDs, for example, one respondent lamented,

> *"The government should invest more in agriculture. We cannot do it all on our own. We've been waiting for government assistance, but it never comes. We cannot afford the new seed varieties and chemicals to cope with the climatic conditions."*

The sentiment was also expressed by an agricultural extension worker who had operated in the area for more than 20 years. He had this to say:

> *"I am the longest serving agricultural extension worker in this region. Farmers rarely get support here. The government is constrained because there are many areas in the country that are hard hit by climate change and resources are few."*

Lastly, insufficient knowledge was mostly seen as a minor (60%) or moderate (25%) barrier. Restricted access to subsidies and inputs was rated major (40%) or very significant (37.5%) by most. High adaptation costs were viewed as a significant (55%) or moderate (22.5%) barrier by the majority.

4.4.6: Level of Support From Different Institutions Major cause of all the changes

Respondents were requested to rate the level of support they receive from different institutions for adopting climate change adaptation measures. The institutions in question included government programs and policies, NGOs, agricultural extension services, local community organizations, and financial institutions. The survey utilized Likert scales ranging from 1 to 5, with 5 indicating maximum support, 4 representing high support, 3 denoting moderate support, 2 indicating low support, and 1 reflecting no support at all. The results, presented in Figure 4.19, provide valuable insights into the perceived support levels of these institutions.

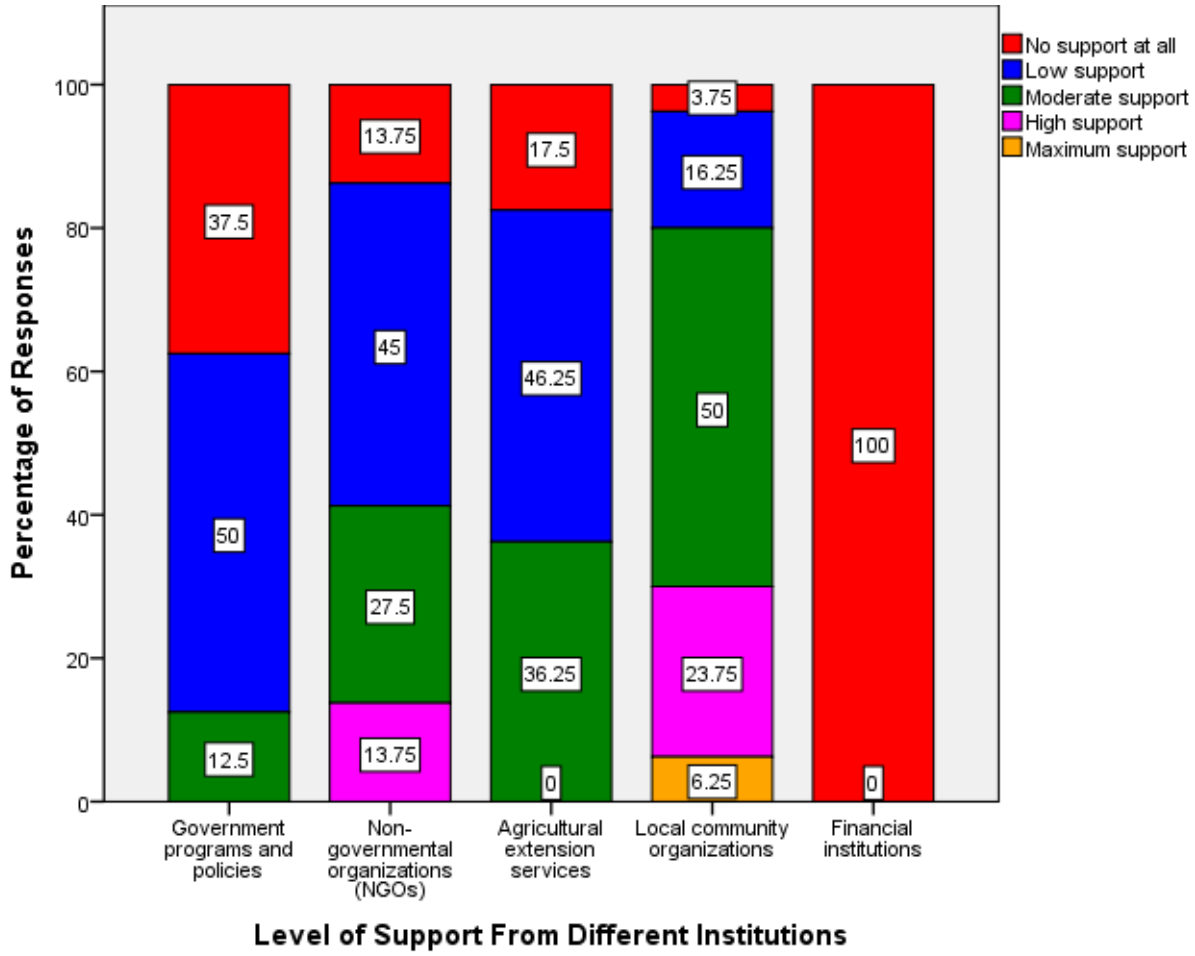

Figure 4.19: Level of Support From Different Institutions

Source: Survey Data (2024)

The survey revealed low support for government programs (50%) and policies, with 37.5% reporting no support. NGOs received mixed ratings, while agricultural extension services had low (46.25%) to moderate (36.25%) support. Local organizations garnered positive ratings, with 50% reporting moderate support and 23.75% perceiving high support. However, financial institutions were unanimously rated as providing no support.

4.4.7 Major Cause of all the Changes

The study investigated respondents' understanding of the primary factor driving the observed changes (Table 4.4). Intriguingly, 33.8% were unfamiliar with the cause. Others attributed changes to altered rainfall patterns (17.5%), shifting weather conditions (11.3%), drought

(11.3%), temperature changes (6.3%), lack of environmental concern (5%), climate change (5%), global warming (3.8%), soil fertility (3.8%), and human actions (2%). Finally, 2% of respondents considered human evilness as the underlying cause, as one farmer expressed,

> *"The disrespect of human beings towards god is the major cause of all the unnatural changes happening nowadays."*

Despite the majority of respondents acknowledging the reality of climate change, they lacked a clear understanding of its role as the underlying driver of the witnessed transformations.

Table 4.4: Major Cause of all the Changes in the Study Area

	Frequency	Percent
Lack of concern towards nature and the environment	4	5.0
Climate change	4	5.0
Fertility of soil	3	3.8
Global warming	3	3.8
Drought	9	11.3
Change in rainfall	14	17.5
Temperature change	5	6.3
Weather change	9	11.3
Result of human evilness	2	2.5
Don't know	27	33.8
Total	80	100.0

Source: Survey Data (2024)

4.4. 8 Additional Support Required for Climate Change Adaptation

In order to ascertain the essential support and resources needed for improving climate change adaptation, survey respondents were asked about additional requirements for effective implementation. Figure 4.20 highlights the key needs and priorities pinpointed by the participants, offering a comprehensive understanding of their perspectives on crucial supplementary support and resources.

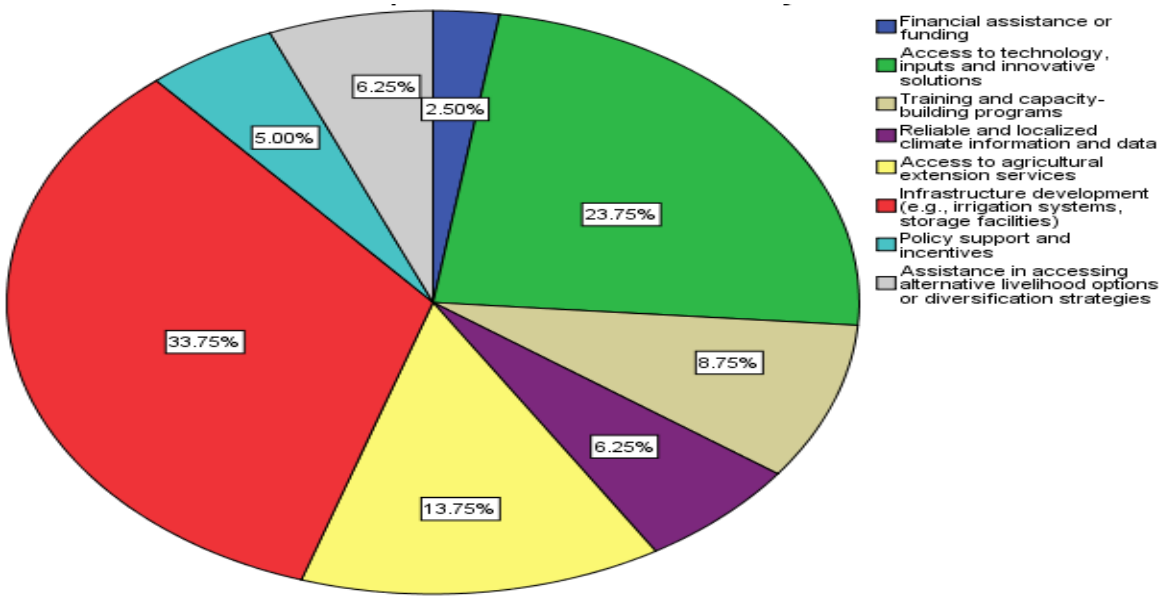

Figure 4.20: Additional Support Required for Climate Change Adaptation

Source: Survey Data (2024)

Infrastructure development emerged as the most critical need, with the majority of participants (33.75%) emphasizing its importance. During the FGDs, respondents consistently highlighted the necessity of irrigation facilities, with one participant stating,

> *"Proper irrigation systems would greatly assist us in adapting to changing rainfall patterns and ensuring the survival of our crops throughout the year."*

The second most prominent category, identified by 23.75% of respondents, emphasized the significance of access to technology, inputs, and innovative solutions. This access enhances the resilience and adaptive capacities of communities and sectors exposed to climate impacts. An

NGO key informant illustrated this need, highlighting NGOs' fundraising efforts to provide farmers with heat-resistant seed varieties, asserting,

> *"Introducing climate-resilient seed varieties is crucial to ensure farmers can continue their agricultural activities despite the changing climate conditions."*

Accessing agricultural extension services ranked third (13.75%) among identified needs, suggesting farmers require this support to effectively implement climate adaptation measures. Training/capacity-building (8.75%) was also seen as important for enhancing adaptation knowledge and skills. Reliable local climate data (6.25%) and assistance with alternative livelihoods (6.25%) were highlighted as crucial requirements. Policy support/incentives (5%) and financial assistance (2.5%) were less frequently mentioned, but recognized as important nonetheless.

4.5. Relationship between Perceived Climate Risk and the Adoption of Adaptive Measures

A cross-tabulation analysis was performed to evaluate the correlation between climate change risk perception and the adoption of adaptive measures among smallholder farmers in Angola's Caluquembe Municipality. The analysis examined the relationship between climate risk awareness levels and adaptation measures. Table 4.5 showcases a robust connection between awareness of climate risks and the implementation of adaptive approaches. The findings reveal that farmers possessing a high level of climate change risk awareness are substantially more inclined to implement various adaptive measures. For example, measures such as modifying planting or harvesting schedules, implementing water conservation techniques, and installing or upgrading irrigation systems are predominantly adopted by farmers with higher levels of awareness. Specifically, 55 out of 56 farmers who adopted these measures fall into the very aware or extremely aware categories. Conversely, farmers with lower awareness show minimal adaptation efforts, as 3 out of 4 slightly aware respondents have taken no action. This trend emphasizes the critical role of awareness in influencing adaptation behavior. The limited adaptation among moderately aware farmers further highlights that even a moderate understanding may be insufficient to drive significant efforts. These insights underscore the

importance of awareness and education in promoting successful adaptation strategies among smallholder farmers.

Table 4.5: Cross-Tabulation of Climate Risk Perception and Adoption Measures

Risk Perception Level/ Adaptation Measure	2 - Slightly aware	3 - Moderately aware	4 - Very aware	5 - Extremely aware	Total
Changed crop selection or rotation	0	0	3	2	5
Implemented water conservation measures	0	1	6	3	10
Installed or upgraded irrigation systems	0	0	4	2	6
Modified planting or harvesting schedules	1	4	30	5	40
Implemented soil conservation practices	0	0	1	0	1
Strengthening early warning systems for extreme	0	0	2	1	3

weather events					
Utilized alternative pest and disease management strategies	0	1	4	1	6
Adopted agroforestry or windbreak practices	0	0	1	0	1
Implemented greenhouse / shade structures/mulching	0	0	1	1	2
Promoting farmer-to-farmer knowledge exchange and learning	0	0	3	0	3
Have done nothing	3	0	0	0	3
Total Respondents	4	6	59	11	80

Source: Survey Data (2024)

4.6 Discussion of Results

The research demonstrates a substantial level of climate change awareness among smallholder farmers, including its associated risks. This awareness serves as a crucial basis for executing suitable adaptation strategies to lessen climate change impacts. Farmers who possess a comprehensive understanding of these challenges are better equipped to make informed choices

and take preemptive actions to protect their farming practices. The findings concur with previous studies, such as Ado et al (2020), which reported comparable high levels of awareness in Niger's Aguie district, emphasizing the significance of widespread recognition in adopting adaptive practices (Fujimori et al, 2022).

The overwhelming majority of respondents viewed climate change as a severe threat to their livelihoods, highlighting the urgent need to address the issue and devise effective strategies to mitigate its impact on agriculture and overall well-being. Consistent with these findings, a related study by Akano et al (2023) on smallholder farmers in Oyo State, Southwest Nigeria, revealed similar apprehensions about climate change's detrimental effects on agricultural productivity and livelihoods. The analogous findings emphasize the widespread challenges smallholder farmers face in adapting to climate change, accentuating the need for interventions and support systems to alleviate its impacts on their well-being.

The research revealed that most participants observed discernible shifts in various farming aspects compared to previous years. Many farmers noted an apparent increase in temperature, while a substantial number expressed concern over declining rainfall. These changes in weather patterns significantly impact agriculture by affecting factors such as workforce, crops, market prices, management practices, and natural resources like water and soil (Balasha et al, 2023). Regarding pests and diseases, a majority reported an increase, while others noticed no change, a decrease, or were uncertain. Studies on plant diseases influenced by climate change indicate its potential to alter pathogen biology, including distribution, disease development, plant-pathogen interactions, and host resistance (Bekuma et al, 2023). As for storms and winds, most respondents observed no notable change, while some experienced an increase, decrease, or remained unsure. Climate change's impacts can vary depending on factors such as exposure time and local geographical, economic, political, social, and cultural contexts (Chen, 2020). Concerning flood, landslide, and soil erosion, a majority reported an increase, while others noticed no change, were unsure, or observed a decrease compared to past years. There is strong evidence linking climate change to increased landslide activities (Correia et al, 2022). Regarding drought, dryness of streams, and underground water sources, many respondents noticed an increase, while others reported a decrease, no change, or were unsure. Climate change is

projected to expand drought-affected areas globally, affecting crop yields and posing challenges for agriculture (Dick-Sagoe et al, 2023). All respondents noted a decrease in productivity and yields compared to previous years. Several studies using integrated assessments and historical data have demonstrated annual crop yield declines due to changing weather patterns (Ogundeji & Okoli, 2022).

The research corroborates existing studies on the substantial impacts of climate change on various aspects of smallholder farmers' livelihoods (Likinaw et al, 2023). The considerable perceived impact on income and household food security aligns with smallholder farmers' heavy reliance on agriculture for their livelihoods (Li et al., 2017), with potential disruptions leading to severe consequences (Nyang'au et al, 2021). The reported impact on crop yields and agricultural productivity mirrors previous studies highlighting agriculture's susceptibility to climate variability (Nyang'au et al, 2021). The significant perceived impact on water quality and availability underscores the vital role of water resources in rural farming communities, as noted by Makuvaro et al (2018) and Megersa et al (2022). Additionally, the considerable impact on soil fertility and nutrient availability reflects concerns about soil health amidst changing climatic conditions (Njoya et al, 2022). These findings emphasize the necessity for targeted interventions and sustainable practices to support smallholder farmers in adapting to climate change and protecting their livelihoods.

Respondents' perspectives on the impact of climate change on farming emphasized the importance of various factors, with rainfall and temperature being the most critical. The reliance on rain-fed agriculture in the region highlights the significance of precipitation patterns and the potential repercussions of changes in rainfall on crop production (Appiah & Guodaar, 2022; Asravor, 2022). Additionally, the diverse perceptions of temperature's impact underscore the potential effects of temperature changes on agricultural output, emphasizing the necessity for adaptation measures, as a one-degree Celsius increase in global mean temperature could lead to yield reductions for various crops without proper adaptation (Balasha et al, 2023). Pests and diseases were perceived to have a significant impact on farming, reflecting climate change's role in influencing the distribution and development of pathogens, insects, and weeds. This emphasizes the need for effective pest and disease management strategies, as climate change

considerably affects factors such as water, temperature, and light, which are crucial for crop growth and development (Batungwanayo et al, 2023; Dick-Sagoe et al, 2023). The varying perceptions of the impact of storms, winds, floods, landslides, soil erosion, drought, and dryness of water sources highlight the complex relationship between climate change and agricultural production. This calls for a multifaceted approach to address the various challenges faced by farmers in the region, as climate change affects the severity and duration of heat and water stress, which can have implications for agricultural output (Etana et al, 2022; Etongo et al, 2022).Finally, the low perceived impact of snow and hailstorms indicates their relative unimportance in the context of local agricultural practices. These findings emphasize the need for a comprehensive understanding of the diverse impacts of climate change on agriculture and the development of targeted interventions to support farmers in adapting to these challenges.

The survey findings indicate that respondents foresee numerous challenges resulting from climate change impacts. The majority anticipated conflicts over land and water resources as the most pressing issue, with historical precedents corroborating the potential for such conflicts to disrupt political and economic conditions on a broader scale (Purwanti et al, 2022). Food insecurity emerged as the second most significant concern, aligning with projections of increased food demands by 2050 and the effect of climate variability on food production (Quarshie, 2022; Shabani & Pauline, 2023). This underscores the importance of addressing food security in light of climate change. A smaller proportion of respondents expressed apprehensions about migration and poverty, which are also supported by previous studies suggesting that climate change may lead to increased migration and worsen poverty and food insecurity (Shrestha et al, 2022; Steenkamp & Thebuho, 2022; Tiet et al, 2022). Collectively, these findings emphasize the necessity for proactive measures to mitigate potential conflicts over land and water resources, ensure food security, and address the wider socioeconomic impacts of climate change.

The research revealed that several factors shape smallholder farmers' understanding of climate risks, with most respondents identifying information shared by friends, family, or colleagues as the most influential factor (Tofu et al, 2022). This emphasizes the crucial role of social networks and interpersonal communication in knowledge sharing among farmers (Steynor et al, 2021), which can be harnessed to disseminate climate-related information and promote climate-resilient

practices. Personal experiences and observations were also recognized as critical factors influencing farmers' comprehension of climate change risks (Tesfahun & Chawla, 2020). This underscores the importance of integrating farmers' experiential knowledge into climate change adaptation and mitigation strategies for context-specific approaches. Although media coverage and public discourse were less prominent factors, their potential impact on farmers' perceptions should not be ignored (Tiet et al, 2022). Collaboration among media outlets, agricultural extension services, and research institutions can help ensure accurate and accessible dissemination of climate change information to farmers. The findings highlight the multifaceted nature of factors shaping smallholder farmers' perception of climate change risks, emphasizing the need for policymakers, extension services, and other stakeholders to tailor their strategies accordingly. By understanding these influences, they can effectively communicate climate-related information and support farmers in building resilience to climate change challenges (Tiet et al, 2022).

Concerning adaptation measures, it became apparent that farmers in Caluquembe Municipality utilize a range of adaptation strategies to manage climate change impacts. The most widespread approach involves adjusting planting and harvesting schedules, enabling farmers to optimize agricultural activities in light of shifting rainfall patterns (Appiah & Guodaar, 2022). Water conservation techniques and irrigation system management also play a crucial role, addressing water scarcity issues intensified by unpredictable rainfall (Correia et al, 2022). The adoption of alternative pest and disease management strategies aims to tackle heightened crop vulnerability under changing climatic conditions (Dzvimbo et al, 2022). Crop diversification and rotation exemplify farmers' adaptability in selecting crops better suited to hot and dry climates, such as small grains, to ensure more consistent yields (Asrat & Simane, 2018). Additional measures, including farmer-to-farmer knowledge exchange, bolstering early warning systems, and executing soil conservation and agroforestry practices, contribute to a comprehensive and sustainable approach to climate change adaptation (Jellason et al, 2019). These findings emphasize the significance of understanding local adaptation strategies and promoting resilience among farming communities in the face of climate change challenges.

The selection of adaptation measures is considerably affected by several factors, with resource availability being the most crucial in the study region. This highlights the significance of financial, technological, and material resources in facilitating effective adaptation (Balasha et al, 2023; Akano et al, 2023). Access to information and knowledge is also vital, as respondents underscored the necessity of disseminating climate-related information and best practices to farmers (Asravor et al, 2022). Respondents also stressed the importance of technical assistance and training programs, which are essential in providing farmers with the necessary skills for adaptation, as corroborated by previous studies emphasizing the role of training in boosting farmers' capacity to implement adaptive measures (Asrat & Simane, 2018). Awareness of climate change risks, observations of improved resilience from other farmers, and concern for long-term sustainability are additional factors shaping farmers' adaptation decisions in the study area, accentuating the intricate interplay of elements involved in climate change adaptation. Comprehending these factors is critical for promoting resilience among farming communities in the face of climate change challenges (Asravor et al, 2022).

In terms of modifications in farming methods to grasp the degree of farmers' adaptation to climate change, a substantial number of respondents acknowledged an elevated likelihood of crop failure due to climate risks, emphasizing the recognition among farmers that climate change poses a significant danger to crop production (Bekuma et al, 2023). Farmers also noted alterations in planting and harvesting schedules, signifying their attempts to harmonize agricultural activities with changing climate patterns, such as fluctuations in rainfall and temperature (Correia et al, 2022). Furthermore, an escalation in off-farm pursuits implies that farmers are diversifying income sources and decreasing sole dependence on agriculture (Dzvimbo et al, 2022). Transformations in land management techniques and crop varieties were also detected, denoting that farmers are embracing novel practices to augment soil health, conserve resources, and select crops better suited to shifting climatic conditions (Etana et al, 2022). While some farmers welcomed technological progressions and adapted irrigation systems, the majority did not considerably modify their tools and equipment. The results illustrate that farmers are adjusting their farming methods in response to climate change, accentuating their cognizance of its impacts and endeavors to alleviate risks through various farming activities.

The research unveiled diverse frequencies at which respondents pursue information on climate change adaptation measures. The majority of respondents disclosed seeking information monthly, signaling a periodic involvement with climate change adaptation. This emphasizes the significance of furnishing regular updates and resources to accommodate this group's information requirements (Balasha et al, 2023). A substantial segment of respondents disclosed infrequent information pursuit, trailed by those who seek information weekly and daily. This indicates a spectrum of engagement levels and awareness concerning climate change adaptation within the surveyed population. A minor fraction of respondents reported never seeking information on climate change adaptation, accentuating the necessity to connect with individuals who may not actively partake in information pursuit, potentially through focused awareness initiatives or customized communication tactics (Tiet et al, 2022).

The research pinpointed multiple obstacles impeding farmers' adoption of effective climate change adaptation measures. Primary barriers comprised inadequate technological resources, restricted access to weather information, and insufficient human resources (Asare-Nuamah et al, 2022; Assan et al, 2020). The absence of government support surfaced as the most substantial barrier, accentuating the necessity for more robust policies and support systems to enable adaptation (Azadi et al, 2019). Limited access to agricultural subsidies and inputs, alongside the steep cost of adaptation, were also recognized as considerable barriers, constraining farmers' capacity to invest in essential technologies and practices (Koirala et al, 2022). These findings underscore the significance of addressing financial constraints and refining access to resources and support for farmers to adapt to climate change effectively.

The study exposed divergent perceptions of support from various institutions engaged in climate change adaptation. Government programs and policies garnered predominantly low support (Akano et al, 2023). NGOs received a comparable blend of low to moderate support evaluations, highlighting their notable role in complementing government efforts (Asravor, 2022). Agricultural extension services were also perceived as furnishing low to moderate support, despite their acknowledged importance in facilitating adaptation within the agricultural sector (Assan et al, 2020). Local community organizations obtained more positive appraisals, with the majority perceiving moderate to high support. This emphasizes the indispensable role of local

institutions in bolstering community resilience and adaptation (Asrat & Simane, 2018). Conversely, financial institutions were unanimously regarded as providing no support whatsoever, signifying a considerable void in their contribution to climate change adaptation measures. These findings accentuate the necessity for bolstered support from various institutions to effectively tackle climate change challenges.

The respondents' viewpoints on the principal factor inciting the observed transformations indicated that a substantial segment of respondents lacked familiarity with the primary factor, suggesting a knowledge deficit concerning the fundamental causes. The respondents ascribed the alterations to several factors, encompassing modified rainfall patterns, evolving weather conditions, drought, temperature fluctuations, dearth of environmental concern, and climate change. Certain respondents also denoted global warming, soil fertility, and human actions as supplementary factors. These outcomes imply that although the respondents acknowledged climate-related shifts, their comprehension of climate change as the root cause fluctuated. This emphasizes the significance of amplifying awareness and imparting precise information about climate change impacts to capacitate individuals and communities to adapt and mitigate risks effectively. The outcomes resonate with earlier research that has discerned an absence of lucidity among smallholders regarding the factors impacting them (Kom et al, 2022).

A cross-tabulation examination probing the degree of climate risk perception and the corresponding extent of adaptation unveils a robust correlation between climate change awareness and the espousal of adaptive strategies. The data infer that farmers who are very aware or extremely aware of climate change risks are substantially more prone to embrace an array of adaptation measures. For instance, initiatives like adjusting planting or harvesting schedules, executing water conservation techniques, and mounting or enhancing irrigation systems are predominantly espoused by farmers with heightened levels of awareness. This harmonizes with the discoveries of Balasha et al (2023) who recorded that elevated climate change awareness prompts a more remarkable inclination to invest in adaptation measures among farmers. Conversely, farmers exhibiting reduced levels of awareness, such as those who are marginally aware, demonstrate negligible adoption of adaptation practices, coinciding with the observations of Bekuma et al (2023) that an absence of comprehension of climate change impacts constitutes

a fundamental impediment to the uptake of adaptive strategies. This pattern stresses the significance of awareness in instigating adaptive behavior (Kom et al, 2022), as comprehensive knowledge and perception of climate risks are pivotal for galvanizing the execution of suitable adaptation measures.

4.7 Chapter Summary

In this chapter, an extensive analysis and exploration of the research findings were conducted, tackling the main questions and thoroughly evaluating the gathered information. The emphasis was on delivering, assessing, and discussing the outcomes pertaining to the connection between climate change risk perceptions and the uptake of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola. These results were examined in connection with the objectives delineated in Chapter One. The conversation covered multiple themes, encompassing the understanding of climate change risks among smallholder farmers, the implementation of adaptive measures as a reaction, and the correlation between perceived risk and the adoption of said measures. The next chapter will offer a summary of the findings, draw conclusions from the study, and provide recommendations based on the results.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction

In the preceding chapter, the study's findings were meticulously examined and assessed. The research questions were addressed, and the data collected was comprehensively analyzed. This chapter aims to summarize the key discoveries related to the research problem and highlight their importance in meeting the study's objectives. As the study concludes, this chapter presents crucial insights from the main findings and suggests recommendations for future research and initiatives.

5.1. Summary

5.1.1 Perceptions of Smallholder Farmers on Climate Change Risk

The study's findings offer significant insights into farmers' awareness, concerns, and perceptions of climate change impacts on their livelihoods and agricultural practices. A notable level of awareness was observed, with 73.75% of respondents indicating they are "Very aware" and 13.75% reporting being "Extremely aware" of climate change. Additionally, 75.0% of respondents view climate change as an extreme threat to their livelihoods. The survey highlights varying concerns about different climate-related risks, particularly changes in rainfall and temperature patterns. For instance, 82.5% of respondents are "Extremely concerned" about changes in rainfall patterns, and 71.25% share similar concerns about temperature changes. Furthermore, a significant majority of respondents, 87.5%, perceive an increase in temperature, while 90% report a decrease in rainfall, indicating significant shifts in climate-related parameters compared to previous years. These changes have substantial implications for agricultural productivity, emphasizing the need for adaptive measures. The study also explores the impacts of climate change on farming activities and livelihoods. Results show that 70% of respondents experience significant impacts on their income and household food security, and 68.75% report substantial effects on crop yields and agricultural productivity. Additionally, respondents identify conflicts over land and water resources and food insecurity as the most pressing future challenges due to climate change. Notably, 46.25% of respondents view conflicts over land and

water resources as the primary concern, underscoring the potential socio-economic consequences for agricultural communities. Lastly, the study examines factors influencing smallholder farmers' perceptions of climate change risks, with 56.25% of respondents citing social networks as a crucial factor, highlighting the importance of peer-to-peer learning and knowledge exchange in enhancing understanding of climate change risks.

5.1.2 Adaptation Measures

The study showed that farmers are using a variety of adaptation strategies to counteract the effects of climate change on their agriculture and livelihoods. The most common approach is adjusting planting or harvesting times, with 50% of farmers adopting this method. This strategy helps them synchronize their farming activities with changing rainfall patterns and fewer rainy days, thereby optimizing crop yields and reducing risks from unpredictable weather. Another significant adaptation method is water conservation, implemented by about 12.5% of respondents. Farmers are conserving water by collecting and storing rainwater through methods such as building small ponds and concrete channels, which help irrigate fields and lessen reliance on unreliable water supplies. Additionally, 7.5% of respondents manage irrigation systems and use alternative pest and disease management strategies, utilizing modern irrigation technologies to ensure consistent water availability and integrating traditional and modern pest control methods to reduce environmental impact. Moreover, 6.3% of respondents have changed their crop selection or rotation patterns, opting for resilient small grains that can endure hot and dry conditions, showing a proactive approach to mitigating climate change effects on crops. Other adaptation practices mentioned include knowledge exchange among farmers, strengthening early warning systems, and adopting soil conservation and agroforestry techniques.

The study examined the factors influencing farmers' decisions on adopting specific adaptation measures, finding that resource availability was the most significant factor, with 86.25% of respondents considering it "Extremely influential." Other important factors included access to information and knowledge, technical assistance and training programs, awareness of climate change risks, evidence of increased resilience from other farmers, market demand for climate-resilient products, concern for long-term sustainability, and cultural and traditional practices. The study also compared current farming methods to those of the past to gauge the extent of farmers'

adaptation to climate change. The results showed a widespread acknowledgment of increased crop failure risks, changes in planting and harvesting times, and participation in off-farm activities. Many farmers reported changes in land management techniques, crop varieties, and irrigation systems, indicating their awareness of climate change impacts and their proactive adaptation efforts.

The study also looked into how farmers seek information about adaptive measures for addressing climate risks, finding that most respondents prefer to obtain information monthly. The study identified several barriers to adopting adaptation strategies, including insufficient technological resources, limited access to weather information, inadequate human resources, lack of government support, and restricted access to agricultural subsidies and inputs. Additionally, government programs and policies, NGOs, and agricultural extension services were seen as providing low to moderate support, highlighting the need for stronger institutional backing to help farmers adapt to climate change in agriculture.

5.1.3 Relationship between Perceived Climate Risk and the Adoption of Adaptive Measures

A cross-tabulation analysis was performed to examine the connection between smallholder farmers' perceptions of climate change risks and their adaptation strategies. The findings show a strong link between climate change awareness and the implementation of adaptation strategies. The data reveal that farmers who are very or extremely aware of climate change risks are much more likely to employ various adaptation measures. Common practices among these farmers include adjusting planting or harvesting schedules, using water conservation methods, and upgrading irrigation systems. This indicates that a higher awareness of climate change is linked to a greater propensity to invest in adaptation strategies. Conversely, farmers with lower levels of awareness, such as those who are only slightly aware, tend to adopt fewer adaptation practices.

5.2 Conclusion

The research outcomes shed light on the perspectives of smallholder farmers regarding climate change risks. A majority of participants demonstrated heightened awareness and apprehension concerning climate change, viewing it as a significant menace to their livelihoods, particularly due to alterations in rainfall and temperature patterns. They noted observable shifts in climate

conditions compared to previous years, such as heightened temperatures and diminished rainfall, significantly impacting agricultural output, income, and household food stability. Future concerns voiced by farmers encompassed potential conflicts over land and water resources, as well as food insecurity.

Regarding adaptation strategies, the study revealed that smallholder farmers are employing diverse tactics to alleviate climate change repercussions. The most prevalent approach involved adjusting planting or harvesting schedules in response to shifting rainfall patterns. Other adaptation methods included water conservation, management of irrigation systems, alternative pest and disease control, and modifications in crop selection or rotation patterns. Farmers' decisions regarding specific adaptation measures were influenced by factors like resource availability, access to information and training, awareness of climate change risks, market demands, and cultural norms.

Furthermore, the investigation delved into the association between perceived climate change risk and the uptake of adaptive measures. An analysis revealed a robust correlation between climate change awareness and the adoption of adaptive strategies. The data indicated that farmers with high levels of awareness regarding climate change risks are significantly more inclined to embrace various adaptation practices. Conversely, those with lower awareness levels tend to implement fewer adaptation measures. These findings underscore the pivotal role of climate change awareness in motivating smallholder farmers to implement adaptive strategies.

5.3 Recommendations

5.3.1 Recommendations for Action or Practice

Drawing from the study's findings, the following recommendations are put forward for stakeholders engaged in agricultural development and climate change adaptation efforts:

- This study highlights the issue of youth migration from rural areas, leaving the farming population predominantly older individuals who may struggle to adopt new technologies and information. To address this, the stakeholders should develop strategies to effectively reach these older farmers with updates on technological advancements. This could

involve creating mobile applications or utilizing accessible media channels to provide timely weather information, enabling informed decision-making. Additionally, introducing user-friendly farming equipment with clear instructions could reduce manual labor, increase productivity, and potentially attract the younger generation to consider agriculture as a viable livelihood option.

- The study also identifies the lack of reliable irrigation systems as a significant challenge for the farming community, which relies heavily on seasonal rainfall. Immediate action from local and provincial authorities is crucial in developing comprehensive irrigation infrastructure, such as canals and water reservoirs, to ensure a steady water supply for farmers throughout the year. The construction of large water reservoirs, fed by nearby water sources, can not only provide a sustainable water source but also create opportunities for supplementary income-generating activities like community-based fish farming.
- Additionally, the study underscores the importance of the government taking an active role in formulating long-term strategies to combat the effects of climate change on agriculture. This should involve launching awareness campaigns, increasing the presence of technical and administrative staff in agricultural areas, dedicating resources to large-scale mitigation and adaptation projects, and offering incentives such as interest-free loans to assist farmers. Moreover, cooperation between the government and the private sector can enhance farmers' livelihoods through the creation and enforcement of insurance policies and the support of research and development initiatives.

5.3.2 Limitation and future Research

The questionnaire did not limit respondents to a specific timeframe for recalling their past experiences, leading farmers to draw on periods ranging from the previous year to several decades ago. This variability could affect the accuracy and reliability of the results. Future longitudinal studies would be beneficial for examining the effectiveness and sustainability of adaptation practices over a longer period. The survey included a sample of 80 farmers and focused on seven indicators of climate change affecting farming practices. Due to this limited scope, the findings might not be applicable to a broader regional or national context. Future research should incorporate methodological improvements, such as larger sample sizes and a

more comprehensive range of climate change indicators, to gain a deeper and more robust understanding of farmers' perceptions and experiences with the impacts of climate change in the region.

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APPENDICIES

Appendix 1: Interview Guide for Key Informant Interviews with Government Officials and NGO Representatives

I am Jabulani Garwi -a student at the Bindura University of Science Education, currently engaged in a research endeavor titled "The Nexus Between Climate Change Risk Perceptions and the Adoption of Adaptive Measures Among Smallholder Farmers in Caluquembe Municipality, Angola." This study is an integral component of my academic journey, undertaken to fulfill the requirements of my program of study. Your participation in this research holds immense significance, and I extend my gratitude for your involvement. The objective of this study is to explore the relationship between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola. Your insights and perspectives are crucial in providing a comprehensive understanding of this nexus.

Your participation in this research is entirely voluntary, and all responses will be treated with utmost confidentiality. Your willingness to actively engage and provide truthful responses to the questions is crucial to the success of this study. It is important to note that your names, positions, and places of work will not be disclosed in any part of this research, ensuring the confidentiality of your input. I acknowledge that your time is valuable, and I assure you that the information you provide will be used solely for the purposes of this study. Your choice to participate or not is entirely at your discretion, and I encourage you to take part wholeheartedly in this voluntary exercise.

Are you willing to participate in this study? 1) Yes….. 2) No……

Section A: Background Information

1. Can you please provide a brief introduction about yourself?

……
……
…….

2. How long have you been working in the field of climate change and agriculture in this region?…….

Section B: Perceptions of Smallholder Farmers on Climate Change Risk

3. How do you assess the current level of awareness and understanding about climate change among smallholder farmers in Caluquembe Municipality?

……
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4. From your perspective, what are the major challenges faced by smallholder farmers in adapting to climate change in Caluquembe Municipality?

……
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.....

5. How do you stay informed about the latest research and developments in climate change and agriculture? What sources of information do you rely on?

…….

6. Do you believe that access to accurate and timely information about climate change is important for smallholder farmers? How does it influence decision-making processes at the government or NGO level?

1. No……

2. Yes……

Explain……
……
……

Section C: **Adaptation Measures**

7. In your role as a government official/NGO representative, what initiatives or programs have been implemented to address climate change impacts on smallholder farming in Caluquembe Municipality?

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8. What strategies or measures have been taken by the government/NGOs to support smallholder farmers in adapting to climate change? How effective have these measures been?

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……
……

9. Are there any specific government policies, programs, or incentives in place to encourage the adoption of adaptive measures among smallholder farmers? If yes, please provide details.

1. No……

2. Yes……

Explain……
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10. How do you collaborate with smallholder farmers and local organizations to address climate change challenges and promote adaptive practices in agriculture?

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11. In your opinion, what are the key factors that contribute to the successful adoption of adaptive measures among smallholder farmers in Caluquembe Municipality?

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12. Are there any barriers or limitations hindering the adoption of adaptive measures by smallholder farmers? If so, what are they, and how are they being addressed?

1. No……

2. Yes……

Explain……
……
……

13. What role do you see community engagement playing in climate change adaptation efforts? Are there any ongoing community-based initiatives or projects that have been successful in this regard?

……
……

14. Are there any specific areas where you feel more support or resources are needed to effectively assist smallholder farmers in adapting to climate change?

1. No……

2. Yes……

Explain……
……

15. Have there been any partnerships or collaborations with external organizations or institutions to enhance climate change adaptation efforts in Caluquembe Municipality? If yes, what were the outcomes or impacts?

1. No……

2. Yes……

Explain……
……

16. How do you envision the future of smallholder farming in Caluquembe Municipality considering the challenges posed by climate change? What steps are being taken to ensure the long-term sustainability of smallholder agriculture?

……
……

17. What do you believe should be the priorities for policymakers and stakeholders in supporting smallholder farmers in adapting to climate change? Are there any specific policy recommendations or actions that you would suggest?

……
……

18. Is there anything else you would like to share or any additional insights you believe are important for this research study?

……
……

Thank you for your cooperation and contribution to making this study a success.

Appendix 2: Questionnaire for Respondents - Smallholder Farmers in Caluquembe Municipality

I am Jabulani Garwi -a student at the Bindura University of Science Education, currently engaged in a research endeavor titled "The Nexus Between Climate Change Risk Perceptions and the Adoption of Adaptive Measures Among Smallholder Farmers in Caluquembe Municipality, Angola." This study is an integral component of my academic journey, undertaken to fulfill the requirements of my program of study. Your participation in this research holds immense significance, and I extend my gratitude for your involvement. The objective of this study is to explore the relationship between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola. Your insights and perspectives are crucial in providing a comprehensive understanding of this nexus.

Your participation in this research is entirely voluntary, and all responses will be treated with utmost confidentiality. Your willingness to actively engage and provide truthful responses to the questions is crucial to the success of this study. It is important to note that your names, positions, and places of work will not be disclosed in any part of this research, ensuring the confidentiality of your input. I acknowledge that your time is valuable, and I assure you that the information you provide will be used solely for the purposes of this study. Your choice to participate or not is entirely at your discretion, and I encourage you to take part wholeheartedly in this voluntary exercise.

Are you willing to participate in this study? 1) Yes….. 2) No……

Instructions: Please signify your response by marking a check (X) in the relevant box or providing a brief statement in the designated sections."

Section A: Social Demographic Characteristics of Respondents

1. What is your gender?

Male ☐ Female ☐

2. What is your age range?

18yrs – 30yrs ☐ 31yrs-40yrs ☐ 41yrs-50yrs ☐ 51yrs and above ☐

3. What is your marital status?

Married ☐ Single ☐ Widow ☐ Widower ☐ Divorced ☐

4. What is your highest level of educational qualification?

No formal education ☐ Primary School ☐ Secondary Education ☐ Tertiary education ☐

5. How many members are there in your household?

Less than 4 members ☐ 4-6 members ☐ 7-9 members ☐ and 10 or more members ☐

Section B: General Farm Information

6. Do you own or manage a farm?

Yes ☐ No ☐

7.Farm Size (in hectares):

Less than 1 ha ☐ 1-5 ha ☐ Over 5 ha ☐

8. Types of Farming Activities:

Crop farming ☐ Livestock farming ☐ Mixed farming (both crops and livestock) ☐ and Other (please specify) ☐

9. Years of Farming Experience:

Less than 5 years ☐ 5 - 10 years ☐ Over 10 years ☐

Section C: Perceptions of Smallholder Farmers on Climate Change Risk

10. On a scale of 1 to 5, please indicate your level of awareness of climate change and its potential risks to your agricultural activities.

1 = Not aware at all

2 = Slightly aware

3 = Moderately aware

4 = Very aware

5 = Extremely aware

11. On a scale of 1 to 5, how significant of a threat do you consider climate change to be for your livelihood?

1 = Not a threat at all

2 = Slightly threatening

3 = Moderately threatening

4 = Very threatening

5 = Extremely threatening

12. Please rate the extent to which you are concerned about the following climate change-related risks **(5 =Extremely concerned, 4 = Very concerned, 3 = Moderately concerned, 2 =Slightly concerned and 1 = Not concerned at all)**

Risk	**Ratings**
Changes in temperature patterns	1 2 3 4 5
Storms and winds	1 2 3 4 5

Changes in rainfall patterns	1 2 3 4 5
Changes in water quality and availability	1 2 3 4 5
Changes in pest and disease prevalence	1 2 3 4 5
Drought, Dryness of streams and underground water source	1 2 3 4 5
Snow and hailstorm	1 2 3 4 5
Flood, landslide and soil erosion	1 2 3 4 5

13. What is your perspective regarding the changes in the following parameters in farming compared to previous years? Please select one response from the options on the right for each parameter on the left.

Parameters	**Increase**	**Decrease**	**No Change**	**Don't know**
Temperature				
Rainfall				
Pests and diseases				
Storms and winds				

Flood, landslide and soil erosion				
Drought, Dryness of streams and underground water source				
Snow and hailstorm				
Productivity and Yields				

14. In your opinion, what do you consider to be the primary change in rainfall patterns compared to previous years? Please choose one option:

a. Alteration in the timing of monsoon onset and withdrawal

b. Reduction in the number of rainy days

c. Heightened instances of untimely rainfall

d. Modification in the intensity and frequency of rainfall

15. How do you perceive the changes in temperature patterns compared to previous years? Please select one response from the options on the right for each option on the left.

a. Number of hot days i) Increased ii) Decreased iii) No change

b. Number of cold days i) Increased ii) Decreased iii) No change

c. Coldness in winter seasons i) Increased ii) Decreased iii) No change

d. Hotness in summer seasons i) Increased ii) Decreased iii) No change

16. Please rate the number from 1-4 for the level of impact on farming of each parameter on the right-side box below **(Significant impact =4, medium impact = 3, low impact = 2 and no impact = 1)**

Parameters	**Ratings**

Temperature	1 2 3 4
Rainfall	1 2 3 4
Pests and diseases	1 2 3 4
Storms and winds	1 2 3 4
Flood, landslides and soil erosion	1 2 3 4
Drought, Dryness of streams and underground water	1 2 3 4
Snow and Hailstorm	1 2 3 4

17. From the parameters listed above, which do you believe has the most significant impact on farming? Please select one parameter and describe the specific effects it has on farming.

……
… ……

18. On a scale of 1 to 4, please rate the impact of climate change on the following aspects (Significant impact =4, medium impact = 3, low impact = 2 and no impact = 1)

Aspect	**Ratings**
Crop yields and agricultural productivity	1 2 3 4

Changes in water availability	1 2 3 4
Changes in water quality	1 2 3 4
Livestock production and animal health	1 2 3 4
Pests and diseases prevalence	1 2 3 4
Soil fertility and nutrient availability	1 2 3 4
Disruption of local markets and access to agricultural inputs	1 2 3 4
Income and household food security	1 2 3 4

19. In your opinion, which of the impacts mentioned in question 18 do you think has the potential to become a major problem in the future? Please select one option.

a. Escalation of poverty

b. Lack of access to adequate food

c. Conflicts arising from the use of land and water resources

d. Increased migration to other areas

e. Threats to social and cultural well-being

20. What are the main factors that influence your perception of the risks associated with climate change? (Please select all that apply)

a. Scientific research and evidence

b. Media coverage and public discourse

c. Personal experiences or observations

d. Information shared by friends, family, or colleagues

e. Other (please specify)

Section D: **Adaptation Measures**

21. How have you adapted your farming practices to address the climate risks mentioned earlier in Section C? Please select the options below that apply to the changes you have made:

a. Changed crop selection or rotation

b. Implemented water conservation measures

c. Installed or upgraded irrigation systems

d. Modified planting or harvesting schedules

e. Implemented soil conservation practices

f. Strengthening early warning systems for extreme weather events

g. Utilized alternative pest and disease management strategies

h. Adopted agroforestry or windbreak practices

i. Utilized cover crops / shade structures / mulching

j. Promoting farmer-to-farmer knowledge exchange and learning

k. Have done nothing

Please explain in detail the changes you have made for each selected option and any additional adaptations you have implemented.

……
……..……

22. What factors influence your decision to adopt climate change adaptation measures on your farm? Please select all that apply and rate the level of influence for each factor on a scale from 1 to 5, where **(5 = Extremely influential, 4 = Very influential, 3 = Moderately influential, 2 = Slightly influential and 1 = Not influential)**

Factor	**Ratings**
Availability of resources	1 2 3 4 5
Access to information and knowledge	1 2 3 4 5
Access to technical assistance and training programs	1 2 3 4 5
Awareness of the potential risks and impacts of climate change	1 2 3 4 5
Evidence of improved resilience and productivity from other farmers	1 2 3 4 5
Market demand for climate-resilient products	1 2 3 4 5
Regulatory requirements or compliance	1 2 3 4 5

Concern for the long-term sustainability of your farm	
Cultural and traditional practices	

23. Have there been any changes in the following areas compared to past years in farming? Please indicate "Yes" or "No" for each parameter on the left side.

Parameters	**yes**	**No**
Variation in types of crops grown		
Potential for crops to fail due to various risks		
Land management techniques		
Tools and machinery employed in farming practices		
Timings for planting and harvesting crops		
Irrigation System		
Off farm activities		

24. How frequently do you seek information about adaptive measures that can be taken to address the risks of climate change?

a. Daily

b. Weekly

c. Monthly

d. Rarely

e. Never

25. Please rate each parameter on a scale of 1 to 5, indicating the level of barrier it presents towards adaptations in farming **(5=Very significant barrier, 4 = Major barrier, 3 = Significant barrier, 2= Moderate barrier and 1 = Minor barrier)**

Barriers	**Ratings**
Insufficient technological resources	1 2 3 4 5
Limited access to weather information	1 2 3 4 5
Inadequate human resources	1 2 3 4 5
Lack of government support	1 2 3 4 5
Insufficient knowledge and awareness	1 2 3 4 5
Restricted access to agricultural subsidies and inputs	1 2 3 4 5
High costs associated with adaptations	1 2 3 4 5

26. Please rate the level of support you receive for adopting climate change adaptation measures from the following sources, on a scale of 1 to 5 **(5 Maximum support, 4 = High support, 3 = Moderate support, 2 = Low support and 1= No support at all)**

Measure	**Ratings**
Government programs and policies	1 2 3 4 5
Non-governmental organizations (NGOs)	1 2 3 4 5
Agricultural extension services	1 2 3 4 5
Local community organizations	1 2 3 4 5
Financial institutions	1 2 3 4 5

27. What, in your opinion, is the primary factor responsible for all the mentioned changes in this questionnaire?

a) ……

b) Don't know

28. What additional support or resources do you need to implement climate change adaptation measures effectively?

……

……

Thank you for your cooperation and contribution to making this study a success.

Appendix 3 Focus Group Discussions Guide for Respondents from Caluquembe Municipality.

I am Jabulani Garwi -a student at the Bindura University of Science Education, currently engaged in a research endeavor titled "The Nexus Between Climate Change Risk Perceptions and the Adoption of Adaptive Measures Among Smallholder Farmers in Caluquembe Municipality, Angola." This study is an integral component of my academic journey, undertaken to fulfill the requirements of my program of study. Your participation in this research holds immense significance, and I extend my gratitude for your involvement. The objective of this study is to explore the relationship between climate change risk perceptions and the adoption of adaptive measures among smallholder farmers in Caluquembe Municipality, Angola. Your insights and perspectives are crucial in providing a comprehensive understanding of this nexus.

Your participation in this research is entirely voluntary, and all responses will be treated with utmost confidentiality. Your willingness to actively engage and provide truthful responses to the questions is crucial to the success of this study. It is important to note that your names, positions, and places of work will not be disclosed in any part of this research, ensuring the confidentiality of your input. I acknowledge that your time is valuable, and I assure you that the information you provide will be used solely for the purposes of this study. Your choice to participate or not is entirely at your discretion, and I encourage you to take part wholeheartedly in this voluntary exercise.

Are you willing to participate in this study? 1) Yes….. 2) No……

Section A: Background Information

1. Can you please introduce yourselves and briefly describe your involvement in smallholder farming in Caluquembe Municipality?

……
……
……

Section B: Perceptions of Smallholder Farmers on Climate Change Risk

2. From your perspective as smallholder farmers, what changes have you observed in weather patterns or climatic conditions that have affected your farming practices in recent years?.....
.....
.....

3. How do these changes in weather patterns and climatic conditions impact your agricultural productivity and livelihoods?

.....
.....
.....

4. In your opinion, what are the most significant climate-related risks that smallholder farmers in Caluquembe Municipality currently face?.

.....
.....
.....

5. How do you stay informed about climate change and its potential impacts on agriculture? What sources of information do you rely on?

.....
.....

Section C: **Adaptation Measures**

6. What measures or strategies have you adopted to adapt to the changing climate conditions in Caluquembe Municipality?

.....
.....
.....

7. Have you faced any challenges or barriers in implementing these adaptive measures? If so, what are they, and how have you addressed them?

1. No……

2. Yes……

Explain……
……
……

8. Do you feel that the perceived risks of climate change influence the adoption of adaptive measures among smallholder farmers? If so, in what ways?

1. No……

2. Yes……

Explain……
……
……

9. How effective do you think the adaptive measures you have implemented have been in mitigating the risks posed by climate change? Have they helped you maintain or improve your agricultural productivity?

……
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……

10. In your experience, what factors contribute to the successful adoption of adaptive measures among smallholder farmers? Are there any motivators or incentives that encourage farmers to adopt these measures?

……
……
…….

11. Are there any external factors or support systems that facilitate or hinder the adoption of adaptive measures? For example, government policies, programs, or initiatives.

1. No……

2. Yes……

Explain……
……
……

12. Have you participated in any community-based initiatives or projects related to climate change adaptation? If yes, could you describe your involvement and the outcomes of those initiatives?

1. No……

2. Yes……

Describe……
……
……

13. How do you collaborate with other smallholder farmers or local organizations to address climate change challenges and implement adaptive measures?

……
……
……....

14. Do you think there is a need for increased collaboration and community engagement in climate change adaptation efforts? If so, what are the potential benefits?

1. No……

2. Yes……

Explain……
……
……

15. Are there any government programs or initiatives that provide support or resources to smallholder farmers for climate change adaptation? Have you accessed any of these programs or resources?

1. No……

2. Yes……

Explain……
……
……

16. In your opinion, what kind of support or assistance would be most beneficial for smallholder farmers in Caluquembe Municipality to adapt to climate change?

……
……
……

17. Are there any financial constraints or limitations that hinder your ability to implement adaptive measures? If yes, how do you manage or overcome these challenges?

1. No……

2. Yes……

Explain……
……
……

18. How do you envision the future of smallholder farming in Caluquembe Municipality considering the challenges posed by climate change?

.....
.....
.....,……

19. What do you think should be the priorities for policymakers and stakeholders in supporting smallholder farmers in adapting to climate change?

……
……
……

20. Is there anything else you would like to share or any additional insights you believe are important for this research study?

……
……
……

Thank you for your cooperation and contribution to making this study a success.

Appendix 4: Letter Requesting for Permission to Conduct Research

18 de dezembro de 2023

Administrador do Município

Município de Caluquembe

Província do Huíla

ANGOLA

ASSUNTO: PEDIDO DE PERMISSÃO PARA REALIZAR PESQUISA NO MUNICÍPIO DE CALUQUEMBE

Caro Senhor,

Espero que esta carta o encontre com boa saúde e em excelentes condições. Meu nome é Jabulani Garwi, e sou estudante da Universidade de Educação em Ciências de Bindura, no Zimbábue. Atualmente, estou cursando um Mestrado em Mudanças Climáticas e Desenvolvimento Sustentável. Escrevo para solicitar permissão para realizar uma pesquisa no Município de Caluquembe, na Província do Huíla.

O título da minha pesquisa é "A Nexus Entre as Percepções de Risco das Mudanças Climáticas e a Adoção de Medidas Adaptativas Entre os Pequenos Agricultores no Município de Caluquembe, Angola". O objetivo da minha pesquisa é explorar a relação entre as percepções de risco das mudanças climáticas e a adoção de medidas adaptativas entre os pequenos agricultores no município.

Para alcançar esses objetivos, planejo empregar uma abordagem de pesquisa de métodos mistos, combinando entrevistas qualitativas, discussões em grupo, observação, questionários e análise de documentos. A pesquisa envolverá a participação de diferentes partes interessadas, incluindo membros da comunidade, organizações não governamentais e autoridades governamentais relevantes. Asseguro-lhe que todos os dados coletados serão tratados com a máxima confidencialidade e utilizados exclusivamente para fins de pesquisa acadêmica.

Solicito gentilmente a sua permissão para acessar o Município de Caluquembe e suas comunidades associadas para fins de coleta de dados. Especificamente, gostaria da oportunidade de conduzir entrevistas, administrar questionários e analisar documentos relevantes. Asseguro-lhe que as atividades de pesquisa serão realizadas com o mais alto profissionalismo, seguindo as diretrizes éticas e respeitando os costumes e regulamentos locais.

Estou confiante de que os resultados desta pesquisa não só contribuirão para o campo acadêmico, mas também fornecerão informações valiosas ao Município de Caluquembe. O conhecimento adquirido com este estudo pode facilitar a tomada de decisões com base em evidências e ajudar a melhorar o envolvimento da comunidade na adaptação às mudanças climáticas.

Agradeço antecipadamente pela sua resposta favorável a este pedido. Estou disponível para quaisquer discussões ou esclarecimentos adicionais que possa precisar. Agradeço a sua consideração à minha solicitação e aguardo com expectativa a sua resposta positiva.

Atenciosamente,

Jabulani Garwi

Telefone: +244 939229698

Appendix 5: Letter Granting Permission to Conduct Research

GOVERNO DE ANGOLA

Adminstrativo Classico do Municipio do Caluquembe
Email: informacao@cmct.gov.ao
Telefone: +244222443768

governo gov ao

Gabinete do Administrador Municipal
Rua do MAT, Complexo Edificio 47, Provincia do HUILA

Referência

Segunda-feira, 22 de janeiro de 2024

Sr. Jabulani Garwi,

PERMISSÃO PARA REALIZAR PESQUISA: MUNICÍPIO DE CALUQUEMBE

Agradecemos sua carta datada de 18 de dezembro de 2023, solicitando permissão para realizar pesquisa no Município de Caluquembe, Província do Huíla, Angola.

Após cuidadosa consideração de sua solicitação, temos o prazer de conceder-lhe permissão para realizar seu projeto Reconhecemos a importância de seu estudo para enfrentar os desafios das mudanças climáticas e seu potencial para contribuir com insights valiosos para nossa comunidade.Por meio desta, você está autorizado a acessar o Município de Caluquembe e suas comunidades associadas para fins de coleta de dados. Você pode conduzir entrevistas, administrar questionários e analisar documentos relevantes conforme detalhado em seu plano de pesquisa.

Por favor, assegure-se de que todas as atividades de pesquisa sejam conduzidas de acordo com as diretrizes éticas e respeitem os costumes e regulamentos locais. Confiamos que você tratará todos os dados coletados com a máxima confidencialidade e exclusivamente para fins de pesquisa acadêmica. Caso necessite de qualquer assistência adicional ou esclarecimento durante o processo de pesquisa, não hesite em nos contatar. Estamos disponíveis para apoiá-lo de qualquer maneira necessária.

Instamos você a compartilhar seus resultados de pesquisa conosco assim que seu estudo for concluído. Acreditamos que seus insights serão valiosos para o desenvolvimento e os processos de tomada de decisão de nossa comunidade.

Desejamos-lhe o melhor sucesso em seus empreendimentos de pesquisa e aguardamos os resultados positivos de seu estudo.

Atenciosamente,

Sr. Pedro Leitão
Administrador do Município
Município de Caluquembe
Província do Huíla

Conselho Distrital Rural
Municipio do Caluquembe
C.P.36 Caluquembe
Provincia do Huila, Angola
22-01-2024
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