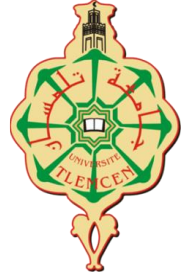




**Institute for Water  
and Energy Sciences  
(incl. Climate Change)**



**PAN-AFRICAN UNIVERSITY  
INSTITUTE FOR WATER AND ENERGY SCIENCES  
(Including CLIMATE CHANGE)**

# **Master Dissertation**

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Presented by

***SALIFU DUMBUYA***

## **TITLE**

**Empowering Resilience: Integrating Climate-Smart Agriculture Communication  
and Education for Sustainable Farming in The Gambia's Central River Region**

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**CERTIFICATION AND APPROVAL**

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Communication and Education for Sustainable Farming in The Gambia's  
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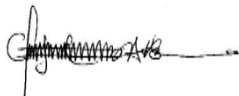
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## **DEDICATION**

This dissertation is dedicated to my late father, my mum, and the entire Dumbuya Kunda family.  
This is for you!

## **ACKNOWLEDGMENTS**

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## ABSTRACT

Climate change has posed a significant threat to agricultural sustainability, especially in vulnerable regions like the Central River Region of The Gambia. Smallholder farmers in this area heavily rely on agriculture for their sustenance, still encountering challenges mainly due to erratic rainfall, prolonged droughts, and degraded soils. Despite the important roles of Climate-Smart Agriculture (CSA) in promoting sustainable agriculture and enhancing resilience, its adoption rate remains low due to insufficient access to CSA communication and education. This study explores the perception and effectiveness of different CSA communication channels, the socioeconomic factors hindering smallholder farmers' access to CSA information, the impact of CSA communication and education in building smallholder farmers' resilience, and how CSA communication and education initiatives differently impact men and women's adoption of CSAPs in the CRR.

Using both quantitative and qualitative approaches, the research gathered data through surveys (n=273), focus group discussions, and key informant interviews. Chi-square tests were done to determine the association between socioeconomic factors and perception of CSA. Findings revealed that only 47% of respondents know about CSA. The regression analysis indicates that access to extension service (coeff. 0.34,  $p < 0.001$ ) and educational level (coeff. 0.265,  $p < 0.05$ ) are important predictors of access to CSA information. Additionally, gender differences are evident, with men being more often in decision-making (coeff. 0.48,  $p < 0.01$ ). The research also assessed the effectiveness of CSA communication channels, indicating that radios were the widely used channel (48.4%), followed by television (47.7%). However, digital platforms remain underutilized, despite their important role in CSA information dissemination.

The study recommended extending extension services as well as incorporating CSA policies into national policies and developing local knowledge-sharing platforms for communities. Similarly, the study recommended increased CSA education together with better communication methods that will give farmers the power to maintain food security while making their farms more resilient to climate changes in The Gambia's Central River Region.

**Keywords:** Climate-Smart Agriculture, Communication and Education, Resilience, Sustainable farming, Central River Region, Gender Disparities

## **ABBREVIATIONS AND ACRONYMS**

ALT – Adult Learning Theory

AR - Agricultural Resilience

CAADP - Comprehensive Africa Agriculture Development Program

CSA - Climate – Smart Agriculture

CSAP - Climate – Smart Agricultural Practices

CSAIPs – Climate-Smart Agricultural Investment Plans

CIS – Climate Information System

CRR – Central River Region

FGD - Focus Group Discussion

ICT – Information Communication and Technology

CCC – Climate Change Communication

CCCE – Climate Change Communication and Education

CC – Climate Change

CT – Communication(s) Theory

SLT – Social Learning Theory

DLT – Diffusion of Learning Theory

MSS – Multi-Stage Sampling

MLR – Multiple Linear Regression

NGOs – Non-Governmental Organizations

SDG – Sustainable Development Goal

ISDR – International Strategy for Disaster Risk Reduction

PBE – Place-Based Education

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## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 BACKGROUND INFORMATION**

The adverse effects of climate change increasingly threaten the global pursuit of sustainable development. These impacts are already being felt, particularly in Africa, and will likely continue unless significant international action is taken (Attfield, 2020; Charles, 2019). Despite contributing the least to global greenhouse gas emissions, Africa faces some of the most severe climate change consequences, including natural disasters like storms, erosion, drought, and flooding (ISDR, 2011). Various African nations are now regularly experiencing these intense and unpredictable natural events (Ndubisi, 2020).

Moreover, the Sahelian climate of The Gambia is characterized by a high degree of variability in annual rainfall. Over the past 50 years, data shows a significant decrease in rainfall, shorter rainy seasons, and an increase in extreme weather events such as storms and droughts (Jaiteh, 2012). Jallow (2018) noted that this declining rainfall negatively affects small-scale farming heavily dependent on rainfall. Consequently, the country's food security and agricultural productivity are threatened, as most agricultural activities rely on consistent precipitation. The Gambia has already suffered substantial economic losses due to climate variability, and these challenges will persist as climate sensitivity remains high. Over the past 40 years, the country's average monthly minimum temperature has increased by 0.40 degrees Celsius while the rainfall trends have not been stable for the past century. The rainfall trend in the Central River Region from 2004 to 2023 reveals notable peaks and valleys as well as notable annual variations. The overall trend shows a slow drop, with an average decline of about 4.94 mm per year, notwithstanding sporadic years with heavy rainfall. This implies that rainfall patterns are becoming more variable, most likely as a result of climate change. The downward trend highlights the need for adaptation measures such as drought-resistant crops, better water management, and climate resilience policies since it presents problems for agriculture, water availability, and ecosystem stability (Ministry of Fisheries and Water Resources, 2023).

Since the mid-1960s, The Gambia has witnessed erratic climate patterns, including unseasonal rains, droughts, cold spells, and other extreme weather events, which are increasingly recognized as manifestations of climate change (Loum & Fogarassy, 2015). These shifts have significantly reduced cereal production, leaving rural households vulnerable to food insecurity.

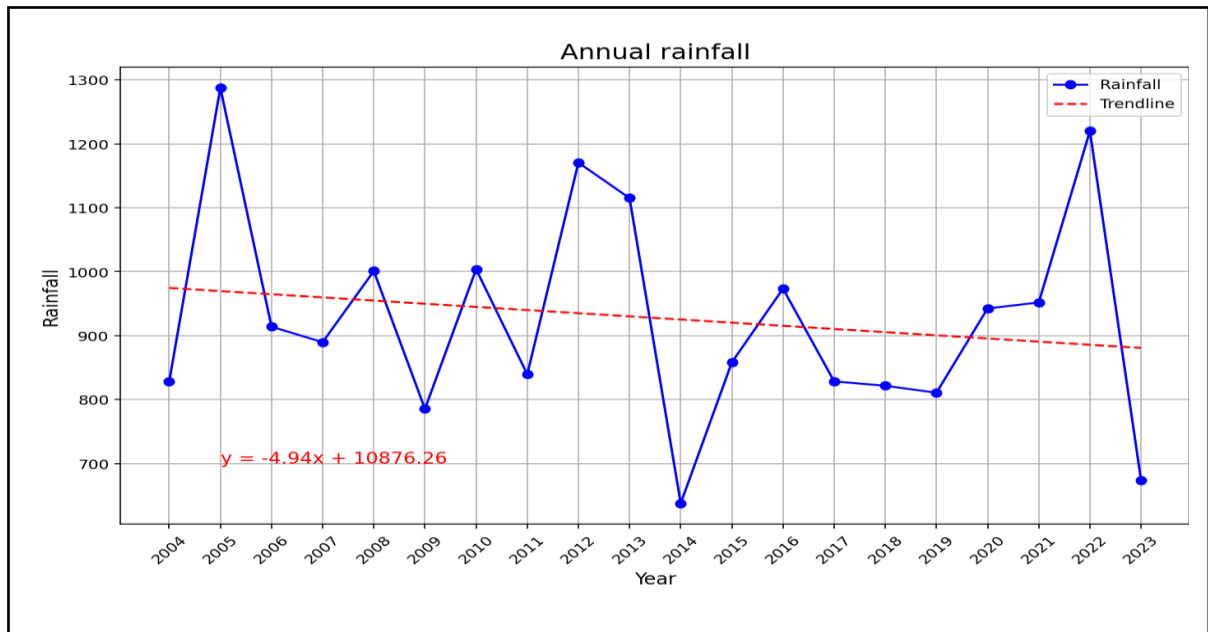
The situation is exacerbated by social, economic, and institutional constraints that limit the capacity of rural communities to cope with these changes (Sonko et al., 2020).

Additionally, rising sea levels, closely linked to climate change, have led to increased salt intrusion, diminishing the productivity of crops, particularly rice grown in marshy areas (Sambou & Ceesay, 2023). According to Bojang et al., (2020), farmers in regions, like Sapu and Kuntaur, reported that rising temperatures have severely affected rice production, particularly during critical stages like flowering and heading. Climate variability has also impacted livestock production, leading to issues such as seasonal feed shortages and increased disease prevalence (Kargbo et al., 2023).

In The Gambia, agriculture plays a critical role in the socio-economic development of smallholder farmers, especially women in rural communities who cultivate vegetables. Approximately 72% of the impoverished rural households depend on agriculture as their primary source of income. The agricultural sector encompasses artisanal fishing, traditional livestock farming, semi-commercial groundnut, and horticultural production, and small-scale subsistence farming, primarily involving rice, groundnuts, and other coarse grains (Ceesay & Ndiaye, 2022). Agriculture contributes 28% to the nation's GDP, and nearly 70% of the population is engaged in agricultural activities (Sanyang, 2023).

The Gambia's agroecological diversity allows for cultivating a wide variety of crops. However, the escalating impacts of climate change threaten food security, employment, and livelihoods dependent on agriculture. Climate-related challenges such as declining crop yields, soil degradation, and extreme weather events have led to significant economic losses (Kutir et al., 2015). Research has shown that slow-onset climate events negatively impact rural communities, leading to crop failures, soil infertility, migration, and the loss of both animal and plant species (Ceesay et al., 2024).

To enhance the resilience of smallholder farmers, it is essential to implement adaptation strategies, particularly through education and capacity development. Effective communication pathways for climate-smart agriculture (CSA) must be developed to ensure that farmers, especially the most vulnerable, can access, understand, and apply these strategies. Implementing CSA can concurrently address biodiversity management, water conservation, and soil health, improving the overall livelihoods of farmers in The Gambia's Central River Region (Sanyang, 2023).



**Figure 1.1** Annual Rainfall Trend for Central River Region from 2004 to 2023

Source: (Ministry of Fisheries and Water Resources, 2023).

## 1.2 Statement of the Problem

Despite the importance of education and effective communication to enhance smallholder farmers' adaptation and resilience to climate change, farmers in the Gambia, particularly in the Central River Region, have not been receiving sufficient climate-smart agriculture information for their farming operations over the years. The absence of extension services among the majority of farmers has detrimental consequences for farmers' awareness of climate conditions and their ability to adjust sustainably. This inadequate access to, or deprivation of, climate change information and proper response techniques hinders their productivity improvement (Kutir et al., 2015). Insufficient and/or lack of efficient communication methods, such as radios and information from extension staff and other NGOs, have hindered the effective and timely transmission of Climate Smart Agriculture (CSA) information to farmers in this region.

The limited availability of climate-smart agriculture information among farmers in this region can be attributed to various factors, including the high cost of communication tools, unreliable internet connections, insufficient extension workers, low literacy rates among farmers, sociocultural norms, and inadequate road infrastructure connecting rural farming communities. The impact of climate change and variability in this region has had a significant negative effect on farmers, impeding their ability to adapt to sustainable agricultural practices, diminishing crop productivity, and adversely affecting their lives and livelihoods. Moreover, given the

critical role of CSA communication and education in promoting sustainable farming practices and ensuring farmers' resilience to climate change, it is imperative to integrate CSA communication and education for sustainable farming in The Gambia's Central River Region

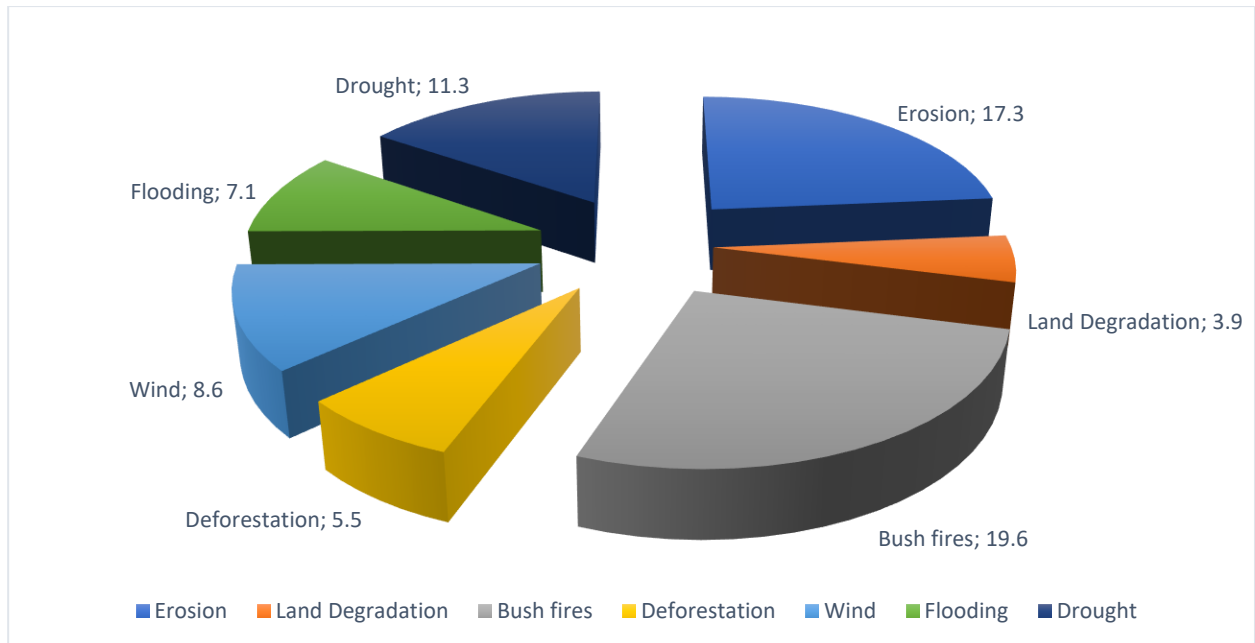
Furthermore, global attention has been drawn to the effects of climate change on human populations and agricultural productivity. Using and promoting CSA practices (CSAPs) is one of the main ways to mitigate the effects of climate change. The low adoption of the practices given to farmers to counteract the effects of climate change on their means of survival can be attributed to several factors, including the efforts employed to reach farmers with the CSAPs communication as climate change adaptation strategies. These obstacles limit the early and overall application of CSAPs (Waaswa et al., 2021).

People's perceptions of and beliefs about climate change are mostly mediated by the different messages and messengers they are most frequently exposed to, as well as their interpretations of those messages, because the phenomenon cannot be immediately seen and felt directly. A one-size-fits-all approach to communication is highly unlikely to succeed in light of the existence of this cultural divide on climate change. Hence, the need for customized communications initiatives, which are simple to advocate for in theory but difficult to put into effect in reality owing to issues like determining the right audiences and message and channel cross-contamination (Markowitz & Guckian, 2018).

According to Bagagnan et al., (2019), empirical evidence gathered in The Gambia has generally demonstrated a drop in precipitation, a reduction in the length of the rainy season, and an increase in the frequency of extreme weather events including storms and drought over the previous 50 years. Additionally, they mentioned that the majority of farmers in the CRR believed they were at risk from severe weather, including droughts, storms, and floods. These conditions have had negative impacts on agricultural production and productivity due to the absence of extension services in most communities. This has posed detrimental consequences for farmers' awareness of climate conditions and their ability to adjust sustainably. This inadequate access to, or deprivation of climate change information and proper response techniques hinders their productivity improvement (Kutir et al., 2015).

Furthermore, farmers' perspectives on climate change and their adaptation strategies are crucial to limiting losses from it since understanding its effects will encourage the application of appropriate adaptation techniques to mitigate its negative effects (Khan & Nawaz, 2020). Inadequate access to efficient CSA communication, through mediums such as radios, mobile phones, Televisions, extension staff, neighbours, friends, and other Non-Governmental

Organizations (NGOs), has hindered the effective and timely transmission of CSA information to farmers in the CRR. This situation has hindered the ability of smallholder farmers to adapt to the impacts of CC, threatened food security, and sustainable agriculture.



**Figure 1.2** Different environmental problems hindering sustainable agriculture in the Central River Region. Climate change and variability in the agricultural production of smallholder farmers in the Gambia further exacerbate these challenges.

Source: (Mungai & Agbe, 2019)



**Figure 1.3** Flood Impacts in the Wassu Rice Fields CRR

Source: Author

### **1.3 Research Questions and Hypothesis**

#### **1.3.1 Research Questions**

- a.** How do smallholder farmers in the CRR perceive CSA, and how effective are the different channels in disseminating CSA information?"
- b.** What socioeconomic factors hinder farmers' access to CSA communication and education in the Central River Region?
- c.** Have CSA communication and education initiatives increased farmers' resilience to climate shocks and extremes in CRR?
- d.** How have CSA communication and education initiatives differently impacted the behaviours of women and men adoption of CSA Practices in CRR?

#### **1.3.2 Research Hypothesis**

**Null hypothesis (H<sub>0</sub>):** Integrating climate-smart agriculture (CSA) communication and education initiatives for farmers in The Gambia's Central River Region will not significantly empower them to embrace more sustainable farming techniques, thus enhancing agricultural resilience in response to climate change.

**Alternative hypothesis (H<sub>1</sub>):** Integrating climate-smart agriculture (CSA) communication and education initiatives for farmers in The Gambia's Central River Region will significantly empower them to embrace more sustainable farming techniques, thus enhancing agricultural resilience in response to climate change.

#### **1.4.1 Overall Objective of the Study**

To assess the effectiveness of integrating climate-smart agriculture (CSA) communication and education initiatives in empowering resilience and promoting sustainable farming practices in The Gambia's Central River Region.

#### **1.4.2 Specific Objectives**

The specific objectives of this study are as follows:

- a. To assess smallholder farmers' perceptions and the effectiveness of different communication channels in disseminating CSA information in the CRR.
- b. Determine the socioeconomic factors that significantly hinder farmers' access to CSA communication and education in the CRR.
- c. Assess the impact of CSA communication and education initiatives on farmers' resilience to climate shocks and extremes.
- d. Assess how CSA communication and education initiatives differently impact men's and women's adoption of CSA practices in CRR.

#### **1.5 Significance of the Study**

Smallholder farmers in the CRR have faced persistent challenges in accessing climate-smart agriculture (CSA) communication and education. To promote sustainable agriculture and strengthen farmers' resilience against climate shocks and extreme weather events, effective dissemination of CSA information is essential. Enhancing access to CSA knowledge will enable smallholder farmers to better adapt to climate variability and change. This research will significantly contribute to the theoretical and practical understanding of CSA communication and education while expanding the body of literature on effective information dissemination channels. By doing so, it will help improve smallholder farmers' awareness and adoption of climate-smart agricultural practices (CSAPs).

Moreover, the study provides valuable insights into the socioeconomic factors that hinder smallholder farmers' access to CSA communication and education in the CRR. A key focus in

the examination of gender-based barriers that affect access to CSA information, will offer a deeper understanding of how gender dynamics influence CSAP adoption. This gender-focused analysis will support policymakers in developing inclusive strategies to integrate CSA communication and education into national policies.

The study also offers evidence-based recommendations for incorporating CSA communication techniques into national policies and agricultural extension programs. By implementing these strategies at the governmental level, food security, agricultural sustainability, and climate resilience can be enhanced in the CRR and beyond. The findings will be valuable for agricultural extension agents and smallholder farmers alike. Extension professionals can leverage these insights to design more effective farmer training initiatives and outreach programs, ensuring that adaptation strategies are communicated in culturally appropriate and locally relevant ways.

Given the significant gaps in research and policy concerning CSA communication and education in The Gambia, this study will provide policymakers and non-state actors with evidence-based information for policy interventions. Furthermore, it will serve as a valuable reference for scholars, students, and researchers conducting related studies. For international organizations, the study's findings will help guide efforts to enhance smallholder farmers' adaptation and resilience to climate change.

## **1.6 Scope of the Study**

This study was done only in the Central River Region of the Gambia. Smallholder farmers both in the north and south of the region were recruited for this study. Communities in the south were Mamud Fana, Galleh Manda, and Sololo, while Wassu, Kuntaur, and Ballanghar were the selected communities in the north.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 CONCEPTUAL FRAMEWORK**

##### **2.1.1 Climate-Smart Agriculture**

The 2030 Agenda asks us to transition to more sustainable methods of production and consumption as well as to improve the efficiency and sustainability of our food and agricultural systems. The FAO introduced the idea of "climate-smart agriculture" in 2010 in response to the growing demand for a clear and comprehensive plan for managing agriculture and food systems in the face of climate change to meet development and food security goals (SIDA, 2017). Since the introduction of the concept of CSA in 2010 by the UNFAO, different authors have defined the concept in different ways. For example, FAO, (2013) defines "climate-smart agriculture" as the practices that strengthen farmers' resilience, increase productivity and income, and mitigate climate change by decreasing emissions of greenhouse gases. Chandra et al., (2018) defined Climate-smart agriculture (CSA) as a strategic approach to tackling climate change and food security. It involves sustainably boosting production, improving resilience, reducing greenhouse gas (GHG) emissions, and promoting the attainment of national food security and development objectives. A list of terms that best describe the essential characteristics of CSA was created by Barasa et al., (2021). The keywords above encompass capacity building, sustainability, profit maximization, reduction of emissions and vulnerabilities, food security, technological advancement, and productivity.

Alexander (2019) also defined climate-smart agriculture as a widely recognized and successful strategy for enhancing agricultural productivity and safeguarding the economic well-being of farmers amid climate unpredictability. Fusco et al., (2020) in their paper titled: 'How to improve the diffusion of CSA: What the Literature Tells', gave three key pillars of CSA which include agronomic and economic productivity, resilience and adaptive capacity, and climate change mitigation.

However, the definition by Alexander (2019) only looks at CSA from the agricultural and economic point of view. Thus, the GHG mitigation and environmental sustainability aspects are not well explained in this definition. Additionally, Climate-Smart Agriculture Practices are context-specific, meaning a particular CSAP that is applicable in one community may not be applicable in the other. Therefore, definitions by Chandra et al., (2018), and Barasa et al., (2021) do not include this quite important aspect of CSA.

Drawing lessons from different studies and online publications about CSA, this study will apply the definition of CSA as " an integrated, context-specific approach to addressing climate change and food insecurity by prioritizing sustainable agricultural practices tailored to local needs, to attain sustainable production and increase income, enhance resilience and adaptive capacity to climate variability and change; while reducing greenhouse gas emissions. CSA explicitly incorporates social equity, gender inclusion, and the participation of vulnerable populations, emphasizing transparent trade-offs and synergies among goals to support equitable and inclusive development outcomes at local, national, and global levels."

### **2.1.2 Climate Communication and Education**

Climate change communication refers to the dissemination of information about the risks and consequences associated with climate change, including the increasing frequency and intensity of extreme weather events such as droughts, heat waves, and heavy rainfall. Individual perceptions of these risks vary significantly, shaped by factors such as social networks, education, values, and other contextual considerations. Consequently, social science research-based approaches are essential for effective communication. These methods have provided valuable insights into how information is conveyed between sources and target audiences, including models emphasizing public involvement (Getson et al., 2022).

Research by (Pearson et al.,2017) highlights the independent and systematic influence of factors such as race, ethnicity, socioeconomic status (including education and income), and gender on attitudes, beliefs, and motivations regarding climate change. These dimensions affect both individual and collective responses to climate issues.

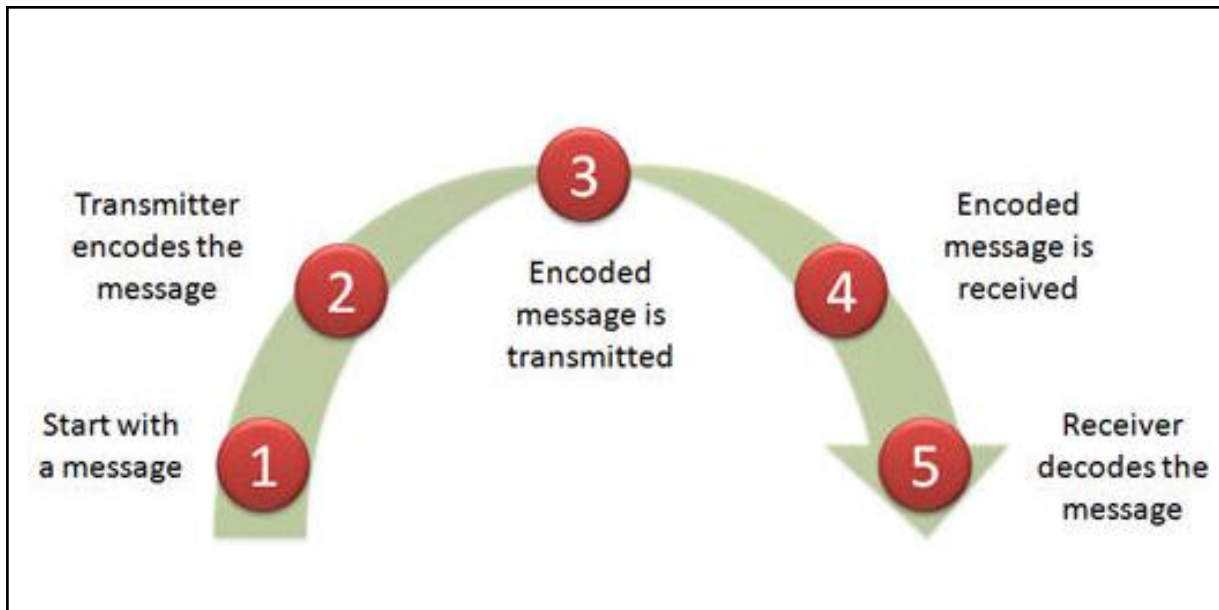
Since its inception in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) has recognized the critical role of "education, training, public awareness, public participation, and public access to information" in mitigating dangerous anthropogenic interference with the climate system (UNFCCC, 1992, Article 6). Similarly, Article 12 of the 2015 Paris Agreement and Sustainable Development Goal (SDG) 13 of the UN Agenda 2030 emphasize the importance of enhancing education, awareness, and institutional capacities in climate change mitigation, adaptation, and early warning systems (McKenzie, 2021).

In the realm of education, (Jacobson et al., 2016) note that the primary aim of Climate Change Education (CCE) and environmental outreach is to foster an interdisciplinary understanding of the built and natural environments across the humanities, sciences, and arts, to promote

knowledge and actionable practices. Furthermore, (Khadka et al.,2021) underscore the effectiveness of local, place-based communication compared to global messaging due to the complex nature of climate change. Their findings suggest that individuals are more likely to perceive risks and mobilize for action when they recognize the local implications of global climate impacts. Place-based education, which emphasizes experiential learning within real-world settings, fosters emotional connections with local communities and serves as an effective starting point for climate education.

Over the years, climate change communication has evolved from practice-driven approaches lacking a strong scientific foundation to becoming a distinct field of study, with a focus on enhancing public engagement (Moser, 2016)

Going forward, CCC and education are defined in this study as an interdisciplinary approach of disseminating information and fostering understanding about the causes, risks, and impacts of climate change as well as promoting actionable solutions. This concept emphasizes effective strategies for engaging diverse audiences by addressing social, cultural, and contextual factors such as values, social networks, education, and local relevance. It encompasses both the dissemination of scientific knowledge and the cultivation of emotional and experiential connections to motivate individuals and communities to adopt climate-resilient and sustainable practices. Central to this framework are place-based and participatory approaches that encourage informed decision-making, public awareness, and collective action to address the complex challenges of climate change.



In **Figure 2.1**, the five basic communication processes are indicated in this figure, beginning with a specific message to the point at which the message is received and decoded by the receiver.

Source: (USAID, 2022)

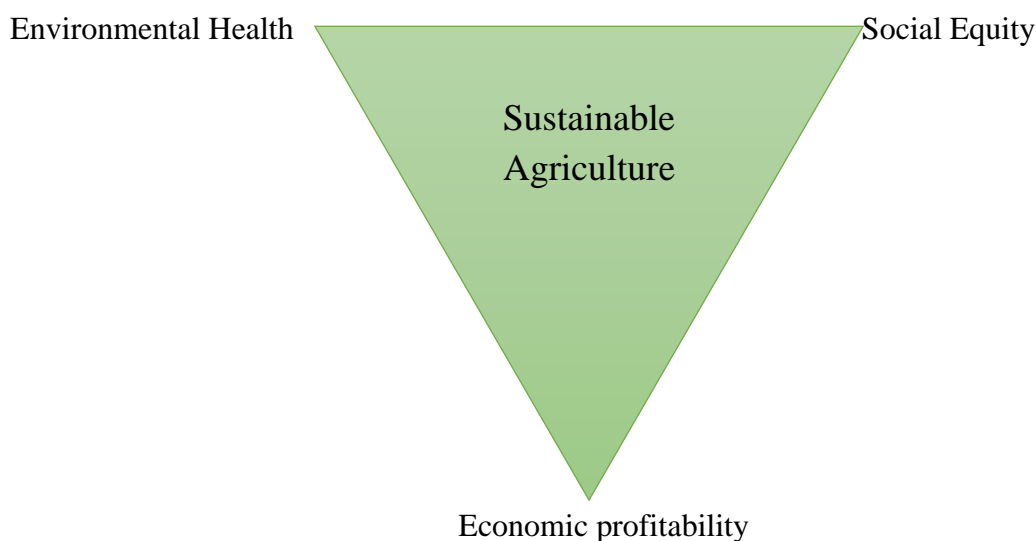
### 2.1.3 Sustainable Farming

In recent years, there has been a growing body of studies on the factors influencing farmers' adoption of ecologically friendly methods. Simply put, sustainable farming refers to agricultural methods whose primary anticipated advantage over conventional methods is the provision of favourable externalities on climate change, biodiversity, water, soil, and landscapes. Such sustainable techniques include rotational grazing, conservation tillage, crop rotation, lowering the use of fertilizers, pesticides, and fungicides, and maintaining the natural landscape (Dessart et al., 2019). Sustainable agriculture is also described as farming systems that can continue their production and usefulness eternally. These systems are characterized by their resource-conserving nature, environmental compatibility, social supportiveness, and commercial competitiveness (Lubell et al., 2011).

Improving soil fertility, biodiversity, and agricultural production are all long-term benefits of managing soil nutrient levels. These factors are critical for securing the security of the world's food supply in the future. The solutions for reducing nutrient surplus are built around a combination of actions meant to maintain soil structure and improve water and nutrient usage efficiency (Serebrennikov et al., 2020).

Three components make up sustainable agriculture: social and economic equity, economic profitability, and environmental health. The UN SDGs now prioritize eradicating hunger and poverty, as well as advancing gender equality and environmental safety, as a result of the inclusion of social elements (Kang, 2020). To ensure and improve food security and improve the lives of rural people, sustainable agriculture and rural development share the objective of raising food production. The creation of new and relevant technology, the effective use of financial incentives, and educational initiatives are all necessary to achieve this goal. These initiatives will guarantee consistent availability of nutrient-dense food, provide jobs and revenue to reduce poverty, and safeguard the environment and natural resources (Baig et al., 2011).

The concept of sustainability by (Sonja, 2019) will be applied in this study, which defines agricultural sustainability as the idea that we must satisfy our current demands without endangering the capacity of future generations to satisfy their own needs. As a result, preserving natural resources for future generations is just as important as pursuing immediate financial benefits.



**Figure 2.2** illustrates the three components of sustainable agriculture

Source: Author's computation from the literature

#### **2.1.4 Resilience in Agriculture**

Resilience is the degree of change a system can withstand and yet maintain its structural integrity and functionalities, according to academic definitions. The definition of socio-ecological systems broadens to take into account a social system's capability for self-organization and for increased adaptability to shifting socioeconomic and environmental

situations (Hammond et al., 2013). Ecological resilience is the capacity of a system to withstand or assimilate disturbances before going through a regime transition, which entails rearranging the system around new procedures, structures, and roles. It makes sense that modern agriculture would be focused on achieving steady, predictable production levels and raising productivity, frequently via boosting efficiency (Sundstrom et al., 2023).

Extreme heat and unpredictable rainfall brought on by climate change will make it more difficult for agriculture to supply food to a growing world population. Thus, depending on cutting-edge techniques, such as genomics and gene editing, crop management techniques, and soil microbiome modification, quick breakthroughs in knowledge and applied crop design may offer answers that improve resilience (Alfonso et al., 2023).

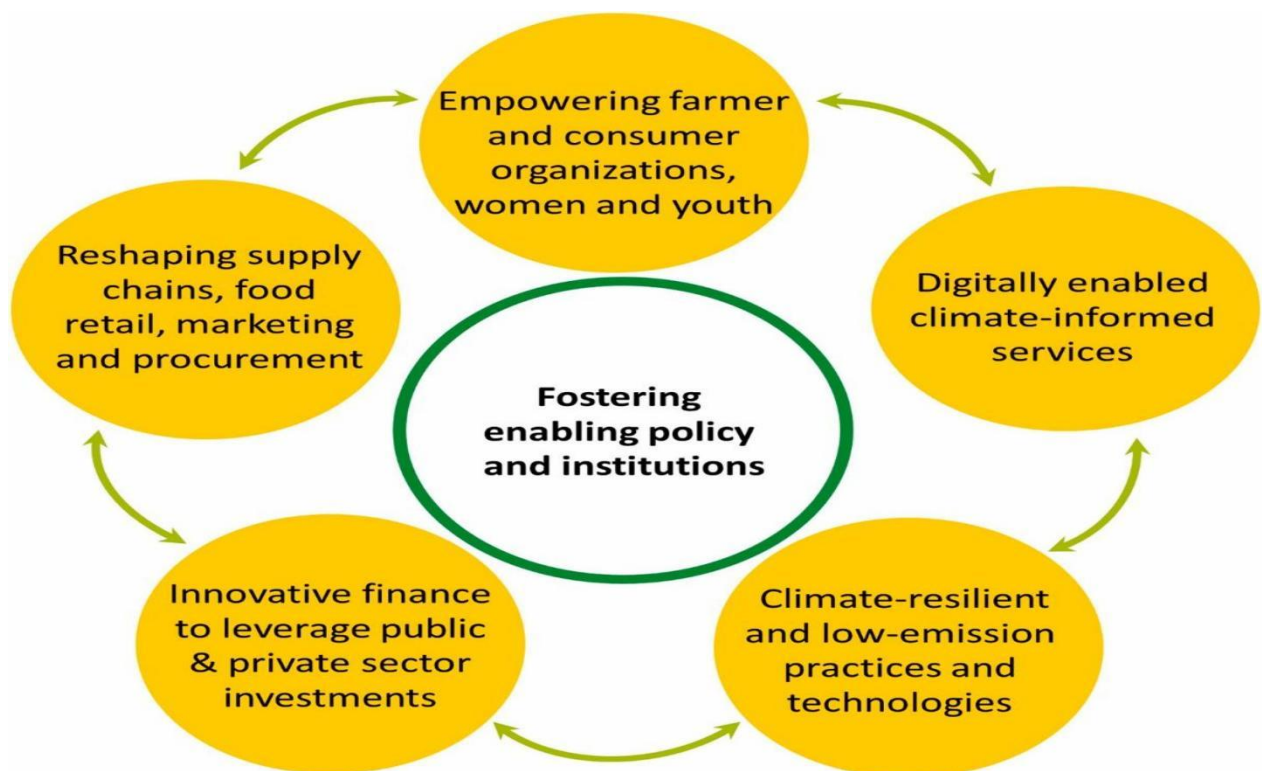
Furthermore, in the event of a severe drought or a significant drop in rainfall, a resilient agroecosystem will continue to supply a crucial service like food production. Given that ecosystems depend on a range of organisms to function and deliver services, crop biodiversity in agricultural systems may serve as the link between stress and resilience (Lin, 2011). Even though agriculture is continually changing, substantial innovation will be required to keep up with the ongoing effects of climate change. The obvious question is how to sustainably produce enough high-quality food for the world's rapidly expanding population. Despite this, scientists studying agriculture have always employed cutting-edge technologies and investigated methods of incorporating them into the agricultural system (Jung et al., 2021).

Researchers consistently conclude that human interaction with the natural world causes adaptation, which involves changes to both physiology and psychology. Psychologists have developed an interest in the adaptive modifications that individuals display in the face of adversity and setbacks. As awareness of the link between stress and health has grown, the idea of "resilience" has surfaced and grown to be a significant field of study (Kalogiannidis et al., 2023).

According to Kuntke et al., (2022), utilizing smart farming tools can help farmers become more resilient by providing accurate information about crop conditions that can be used to plan farming methods based on particular phenological stages. This can improve the timing of harvest, control of pests, and yield protection. Investments in risk monitoring and early warning systems, environmental preservation, ecological biodiversity restoration, damaged system rehabilitation, and the development of more efficient and sustainable production techniques will all be necessary to increase farmers' resilience. This will contribute to the development of a resilient agricultural system that strikes a balance between robustness, adaptability, and

transformability in the face of threats to its capacity to carry out essential tasks, such as the provision of food and non-food ecosystem services (Bennett et al., 2021; Kalogiannidis et al., 2023).

Finally, when the fundamental circumstances for its operation become unfeasible, resilient agriculture must be able to adapt to new modes of operation without causing undue harm to natural or human systems. It is crucial to know when, where, and how much perseverance, adaptation, or change is required. Many actions are being taken to increase tenacity and adjust to changes. Several of these actions have long-term advantages. Some may be beneficial in the short run, but if they are prolonged, they may be detrimental in the long run. For instance, governments may use subsidies or other forms of intervention to address short-term issues, but these measures ultimately impede longer-term, more advantageous improvements since agriculturalists grow reliant on subsidies and continue to use unsuitable methods (E. Bennett et al., 2014). In this study, definitions by (Hammond et al., 2013) and (Sundstrom et al., 2023) will be applied.



**Figure 2.3** indicates the essential elements needed for the transformation of a better food system under climate change. It illustrates the key strategies for developing a resilient food system. (Suri, 2024)

Link : (<https://www.orfonline.org/expert-speak/creating-climate-resilient-food-systems>)

## **2.2 Theoretical Framework**

### **2.2.1 Communication(s) Theory**

The word "communication," which comes from the Latin word "Communis," refers to the act of sharing, imparting, and participating as well as the idea of bringing something common to people. The complex process of two or more people discussing and exchanging thoughts, feelings, information, and experiences is referred to as communication (Mallick & Anshuman, 2023). The theory of communication was first propounded by S. F. Scudder in the year 1980. It asserts that, despite their varied modes of communication, all living things on Earth exchange information. The academic discipline of communication science studies human interaction in a variety of settings, including interpersonal, group, organizational, and mediated. Communication (without an s) has a broader connotation. It refers to the connection and exchange of information between individuals. In contrast, the term communications (with an s) is frequently used to refer to communications technology or systems for sending and receiving messages (Ballantyne, 2016). We may learn the most about human nature from the standpoint of communication. Humans are "symbol makers," "symbol misusers," and "symbol users." These findings show that people use communication to manage their relationships with one another, express their emotions, discuss their perspectives on reality, and spread persuasive and educational ideas through the media (Heath & Bryant, 2000). In addition, Hò, (2006) asserted that information exchange, the asking, giving, and exchanging of knowledge to eliminate uncertainty, is a fundamental human function. Therefore, obtaining information to reduce uncertainty is one of the driving forces behind interpersonal communication.

Furthermore, Broad et al., (2013) defined communication as the network of resource relations for communication that an individual builds in the context of their communication environment while pursuing a goal. The work makes the case that practitioners can use an understanding of communication ecologies. This term describes the networks of communication connections that individuals or groups rely on to accomplish a goal, strengthen a neighbourhood's communication infrastructure, and promote social change. From the standpoint of communicative ecology, every instance of media use is viewed as a component of a complex media environment framed by social and cultural factors, both at the individual and community levels. Our analysis extends beyond conventional print, broadcast, and telecommunication media to encompass peer-to-peer communication through social networking applications, in-person interactions via transportation infrastructure, and public and private spaces where people congregate, converse, and engage in gossip (Hearn & Foth, 2007).

This theory was applied in assessing the public's perception of and interaction with climate science in Norway, which was examined using the idea of communication. Similarly, in India, the theory was used to explore the role of ICT in sustainable development and gender dynamics in agriculture (Mallick & Anshuman, 2023; Ryghaug, 2016). Furthermore, the effective and sustainable mainstreaming of climate change in development, mitigation, and adaptation policies, as well as collective behavioural change and, more specifically, attitudes towards climate change mitigation for better efforts to reduce greenhouse gas emissions, all depend on CCC ( Filho et al., 2018).

This study will use the communication theory and its application in CSA communication and education for sustainable farming in the CRR. For instance, the theory will guide us to understand how information flow, knowledge sharing, social learning, and communication can serve as a driver of CSA adoption (awareness creation, behaviour change, and capacity building), the role of communication in building resilience, customized communication strategy, and stakeholder engagement.

### **2.2.2 Social Learning Theory**

The fundamental idea of the social learning theory is that we pick up knowledge through social interactions with other people. People independently acquire comparable behaviours from seeing the actions of others. People absorb and copy other people's behaviour after witnessing it, particularly if their observational experiences are rewarding or involve rewards associated with the observed behaviour (Nabavi & Bijandi, 2023). The concept of social learning originated from Bandura's observations of how individuals learn in a social context by creating mental models based on observation. However, theories of "situated learning," which place more emphasis on the social environment and how it shapes learning, are more relevant to modern approaches to climate change and natural resource management (Ensor & Harvey, 2015).

Furthermore, building resilience and attaining sustainability may depend heavily on social learning among relevant stakeholders (Clemens et al., 2016). The theory of social learning is being highlighted increasingly as a crucial element of managing natural resources sustainably and encouraging positive changes in behaviour. Social learning is regarded as a crucial channel for addressing "wicked" problems like climate change adaptation, which are marked by difficulties in defining and attributing causes, uncertainty, and ambiguous solutions. Consequently, changing our thinking as individuals or as a group is necessary for social learning

for change. Investigating the process of climate change adaptation appears to be a promising area for this kind of learning (Harvey et al, 2013).

Li et al., (2018) observed in their study, "Role of Social Learning in the Diffusion of Environmentally-Friendly Agricultural Technology in China," that social learning, which is based on farmers' social networks, can improve human communication and information exchange, which helps to lower the uncertainty associated with implementing new agricultural technologies. Because of this, there has been a greater focus on the function of social learning in the implementation and growth of sustainable agricultural technology. The construction of the learner as a person or social entity establishes a connection between individual learning and collective social change processes, such as the adaptation of a family, organization, or country. Therefore, social adaptation can be thought of as group learning. This acknowledges the interaction of learning and adaptive behaviour at these several levels rather than arguing that individual and group behaviour are qualitatively the same (Pelling & High, 2005). For a process to be classified as "social learning," according to Scholz & Methner, (2020), it must: (1) show that the individuals involved have changed in their understanding; (2) show that this change extends beyond the individual, and is situated within larger social units or communities of practice; and (3) occur through social interactions and processes between actors within a social network. Thus, a more sustainable society can be fostered through transformative social learning. Transformative learning is a complete model that can assist in analyzing individual learning processes to find knowledge that can be applied to assist individuals in overcoming obstacles related to climate change adaptation (Phuong et al., 2019).

This study will also make use of the SLT to understand how smallholder farmers in the CRR learn new Climate-Smart Agricultural Practices (CSAPs) through peers or friends and neighbours. The theory shall also help us determine how CSA communication and education initiatives differently impact men's and women's adoption of CSAPs through various social structures that may influence learning opportunities.

### **2.2.3 Diffusion of Learning Theory**

Diffusion is the process by which an innovation spreads over time among the various parts of a social system through specific pathways. In actuality, diffusion consists of three very separate processes: introducing the new cultural element or aspects to society, getting their approval, and incorporating the approved element or elements into the already-existing culture (Dearing, 2009). Social networks are becoming more and more significant in our lives, especially when

it comes to the development and dissemination of ideas. A lot of the decisions we make are socially constructed, and we often base them on observations of other people's behaviour (Lobel & Sadler, 2015). Farmers have decisions and trade-offs to make when implementing new technologies. The fact that farmers come from diverse cultural and socioeconomic backgrounds, with varying resource endowments, goals, and preferences, frequently contributes to differences in adoption decisions. Consequently, while some farmers use the new technology, others do not (Haque, 2017).

The diffusion theory is a crucial theory that explains the process of change, such as the spread of innovations in society, and was created in the United States by rural sociologists. Taking into account the innovation's features, social relationships, time constraints, and individual and group characteristics, this theory makes an effort to forecast how people would behave while adopting new ideas (Simin & Jankovic, 2014). Innovation is any concept, method, or item that a person or other adoption unit views as new. Another kind of societal transformation is the diffusion of innovation. It's a social process where communication between people is involved. To arrive at a shared understanding, players in the communication process generate and exchange information. Diffusion is a unique mode of communication about new ideas (Mardiana & Kembauw, 2021). Furthermore, according to the theory, deciding to embrace innovation is seen as a cognitive process that includes learning about the technology, persuading, decision-making, implementation, and confirmation. Adoption perception about the perceived advantage of agricultural technology is therefore crucial to adoption as part of the knowledge of the diffusion of innovations theory's persuasion and decision stages (Teklu et al., 2023b).

#### **2.2.4 Adult Learning Theory**

This theory was developed in the year 1968 by Malcolm Knowles. It is also known as the theory of andragogy. Adult learning was thought to be a cognitive process in which the mind processed facts and information into knowledge, which was subsequently manifested as changes in behaviour (Merriam, 2008). When it comes to adult learning, identity is very crucial. Mature people have already established identities that shape their viewpoints and attitudes. Adults frequently engage in new educational experiences to adopt new identities or enhance pre-existing ones. Adults in educational environments occasionally have a driving motivation to adopt a new identity (Levitan, 2016). The basic principle of this educational approach is that adults learn primarily from their experiences and interests and that they are most productive when given the freedom to apply new information to their lives (Schattman et al., 2019). Being

literate is essential for learning, communication, and information gathering. It is also practically a requirement for personal growth and the advancement of a country (Kapur, 2015).

Since more workers in the agricultural sector do not have specialized agricultural training, adult learning is especially significant in this area.

Therefore, the goals of adult learning are focused on three different categories of demands in socio-economic development: the needs and aims of the individual, the needs and objectives of the institution, and the needs and objectives of the society (Rusu et al., 2020). To keep their viability and competitiveness in agriculture, farmers rely on a variety of sources for information about marketing, financial planning, and management strategies. Formal and informal networks can facilitate the transmission of certain types of knowledge. A "top-down" approach to knowledge dissemination from "expert" to "layperson" is used by agricultural extension agents or crop consultants in official networks. Peer relationships are a feature of informal networks, usually resulting from agricultural social interactions (Velardi et al., 2021). For any approach to be effective, it must therefore be tailored to the unique circumstances of a farm with farmers and technical advisors serving as the primary participants in adult learning, a holistic approach of characterization, diagnosis, redesign, implementation, and assessment can be used to accomplish such changes (Barrantes & Yagüe, 2015).

## **2.3 Empirical Review**

### **2.3.1 Farmers' Perceptions of Climate-Smart Agriculture**

Inappropriate farming methods and climate change significantly affect land productivity in the long term. Moutouama et al. (2022) evaluated farmers' perceptions of climate-smart agricultural practices (CSAPs) in Northern Benin and found that only 11 out of 31 CSAPs were recognized by more than half of the farmers, highlighting the low level of awareness of these practices in the region. Several factors influence the perception of CSAPs in Southeast Nigeria, including farmers' educational attainment, income, access to credit, extension services, livestock ownership, agricultural experience, cultivated land size, proximity to markets, distance to water resources, leadership roles, risk orientation, gender, land ownership, family size, and information exposure (Ariom et al, 2022). Similarly, Samoura et al, (2023) observed that some small-scale farmers lack awareness of significant environmental changes due to limited formal education and increasing weather disruptions. Their research revealed a poor adoption rate of CSAPs in the Guinean Savanna, with average adoption rates below 50%, except for crop diversification. Consequently, awareness-raising initiatives are necessary in rural areas where a

significant portion of the population relies on agriculture without formal education. Farmers' perceptions of climate change and adaptation strategies are shaped by personal experiences, available information, risk tolerance, and the potential outcomes of their decisions (Alhassan & Haruna, 2024). A critical determinant of farmers' adoption of climate-smart farming methods in sub-Saharan Africa is their perception of climate change (Meshesha et al., 2022).

In The Gambia, limited research has explored farmers' perceptions of climate-smart agriculture. In the Central River Region, studies such as those by Bagagnan, et al., (2019) have examined perceived climatic variability and farm-level adaptation but have not rigorously addressed the gendered and socioeconomic factors influencing perceptions of CSAPs. Similarly, studies by Lehnhardt et al.,(2024) and Yaffa, (2013) did not specifically focus on the Central River Region, often referred to as the country's "food basket," nor did they delve deeply into farmers' perceptions of CSAPs. Despite existing knowledge about factors influencing the adoption of CSAPs, several obstacles hinder effective climate change adaptation, including institutional barriers that impede the implementation of CSA initiatives in rural areas (Totin et al., 2018).

Lastly, Barasa et al., (2021) conducted a systematic review of CSA research across Africa, demonstrating that many countries adopted CSAPs to address challenges associated with low agricultural productivity. Furthermore, the study identified a lack of climate-smart agricultural investment plans (CSAIPs) in many nations, which has hindered both the adoption and perception of CSAPs.

### **2.3.2 Effective communication channels in disseminating CSA information to farmers**

The effective dissemination of accurate information about CSAPs through appropriate channels targeted at specific audiences is essential for improving adoption rates. Inclusive communication strategies that engage all farmers, including women, are particularly critical, as they promote empowerment and contribute to achieving the Sustainable Development Goals (SDGs) by addressing food insecurity, malnutrition, and poverty (Waaswa et al., 2021). Extension agents play a pivotal role in this process by disseminating climate change research findings to enhance farmers' knowledge and awareness. This, in turn, equips farmers to recognize and implement coping mechanisms for climatic variability (Maka et al., 2019).

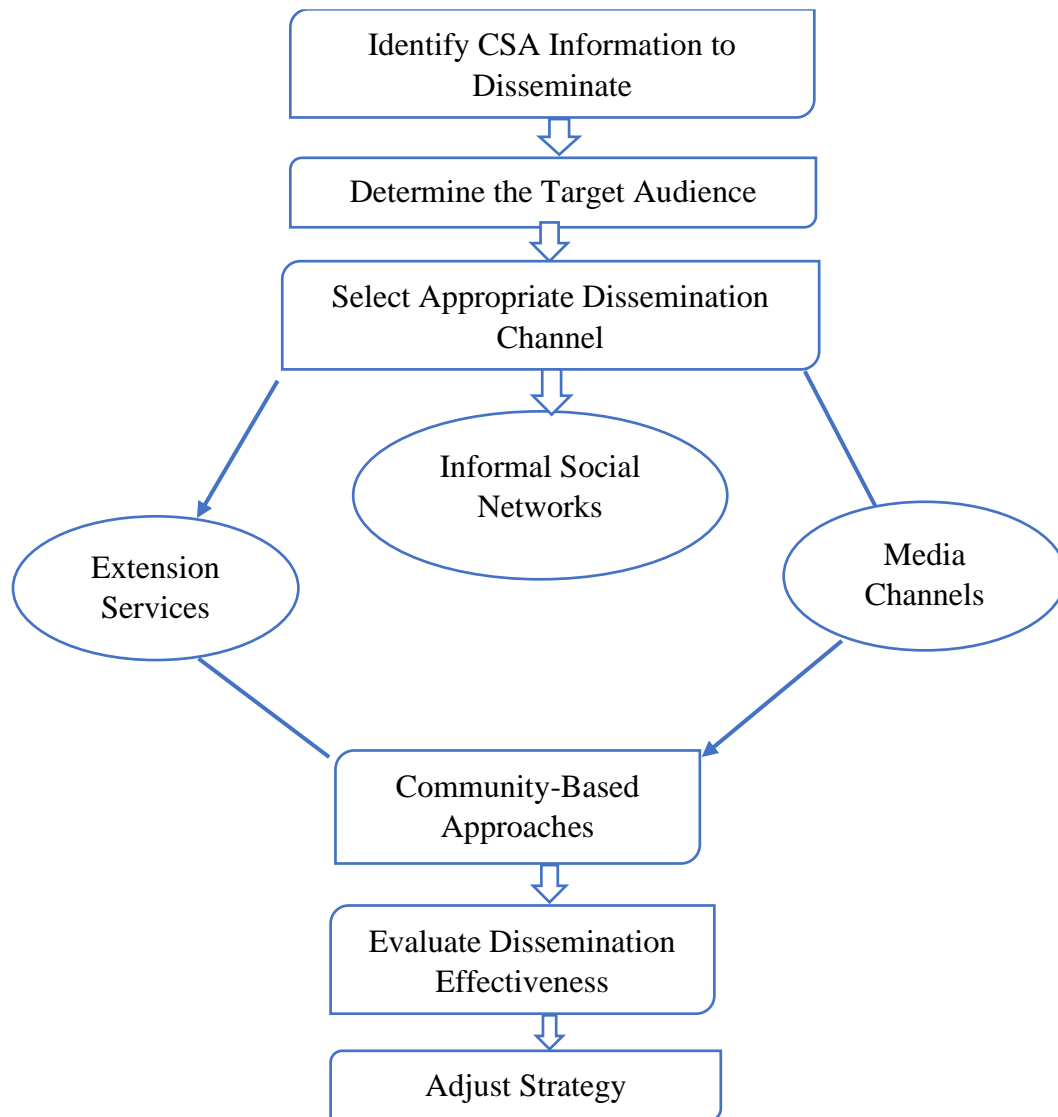
A study conducted by Waaswa et al., (2021) in Gilgi sub-county, Kenya, found that extension officers were the primary source of CSAP information for potato farmers, followed by friends

and neighbours, and then the media. The reliance on extension officers was associated with higher awareness and adoption rates of CSAPs among these farmers. Similarly, Mbukwa, (2015) identified extension agents as the most preferred communication channel in Bolero, Rumph District, Malawi, followed by lead farmers. However, radio emerged as a popular and trusted medium due to its accessibility, reliability, and comprehension among farmers. Despite these insights, Mbukwa's study did not adequately examine how socioeconomic and gender-related factors hinder farmers' access to CSAP information.

Informal social networks, farmer-to-farmer interactions, and farm visits also play a significant role in influencing the adoption of new agricultural technologies. These interpersonal relationships determine the timing, acceptance, and dissemination of information (Nyasimi et al., 2017). However, gender disparities persist in the availability and accessibility of agricultural training, extension services, and technologies necessary for adapting to climate change. Women often face barriers at all stages of technology adoption, from awareness to testing and sustained use. For example, Awiti, (2022) revealed that institutional and cultural constraints impeded women's adoption of rice-producing technologies in Tanzania, Madagascar, and Ethiopia.

In rural Kenya, Ngigi et al., (2017) found that men had greater access than women to critical agricultural and climate information, including crop and livestock production, extension services, and early warning systems for extreme weather events. These disparities can limit women's ability to employ adaptive methods and access alternative livelihoods, particularly as they often have fewer educational and employment opportunities compared to men (Adeola et al., 2024). Addressing these barriers is critical to fostering equitable adoption of CSAPs.

In the context of The Gambia, particularly the Central River Region (CRR), there is limited research on the effective dissemination of CSA information. While Otaiku's, (2018) explored aspects of information sharing in his study on The Gambia Agro-Corridor and value chain development, the analysis did not thoroughly investigate the most effective channels for CSA information dissemination. This gap highlights the need for targeted studies to identify best practices for ensuring timely and equitable access to CSA information.



**Figure 2.4** shows how CSA information can be effectively disseminated to smallholder farmers  
Source: Author’s computation from the literature

### 2.3.3 Socioeconomic factors hindering farmers' access to CSA communication and education

The Access to Climate-Smart Agricultural Practices (CSAPs) is influenced by various socioeconomic factors, including geographical location, farmer demographics, institutional characteristics, biophysical variables, and the specific practice under consideration. It is also critical to examine the determinants of adoption intensity, as smallholder farmers may deliberate the integration of technologies into their farming systems (Musafiri et al., 2022).

Research by Alhassan & Haruna, (2023) highlights that household income and plot size significantly influence farmers' adaptability to climate change in Ethiopia and Nigeria. Farmers

with extensive land holdings, who face the risk of substantial output losses, are particularly more inclined to adopt climate change adaptation strategies. This underscores the importance of community social networks and agricultural extension programs in shaping rural farmers' adaptation decisions in both countries. Similarly, a study by Mogaka et al., (2021) on the socioeconomic factors influencing the adoption of climate-smart soil practices among farmers in western Kenya revealed that farm size and ownership significantly impact smallholder farmers' access to and adoption of CSAPs.

Smallholder farmers face numerous challenges in accessing information on Climate-Smart Agriculture (CSA) technologies. These challenges include biophysical, socioeconomic, and institutional limitations, as well as constraints related to legislative frameworks, willingness to invest, availability of climate information, and gender-based disparities. Gender perspectives are particularly crucial when analyzing the adoption of CSA practices. Social structures, gender roles, and cultural norms strongly influence agricultural practices, and women play a significant role in climate change adaptation. However, female farmers often face additional barriers to implementing CSA technologies, such as the high cost of inputs, limited access to credit, and greater demands on revenue and labor (Ngigi & Muange, 2022).

Additionally, research by Samoura et al, (2023) identifies several socioeconomic attributes that affect farmers' access to CSA information. These include educational attainment, age, gender, livestock ownership, agricultural practices, access to income from non-farm activities, perceived consequences of climate change, and membership in farmer-based organizations.

#### **2.3.4 CSA communication and education initiatives and its impact on farmers' resilience to climate shocks and extremes**

Enhancing the capacities of smallholder farmers is critical for enabling them to better withstand the adverse effects of climate change. These capacities encompass not only responsive abilities but also the capacity for innovation, learning, and anticipation to prepare for the anticipated impacts of a changing climate on agricultural systems (Teklu et al., 2023a). In a study conducted in Ghana, Demba et al. (2024) investigated Climate-Smart Agriculture (CSA) and Climate Information Services (CIS). The research underscored the importance of region-specific strategies, such as stress-tolerant crop cultivars and integrated crop-livestock systems, in strengthening agricultural resilience. CIS was identified as essential across all regions, as it empowers informed decision-making by farmers. The study advocates for customized CSA

interventions and improved delivery of CIS to facilitate adaptation to climate change, emphasizing the necessity of capacity building and greater access to climate information (Kayusi et al., 2024; Damba et al., 2022).

Recent findings by Kayusi et al., (2024) highlight substantial growth in the adoption of CIS across Africa, with a 35% increase in the past five years. This rise reflects an increasing recognition of CIS as a vital tool for agricultural decision-making and enhancing climate resilience. However, female farmers continue to face significant barriers in accessing CIS, being 30% less likely to use these tools than their male counterparts. Factors contributing to this disparity include limited access to education and technology, cultural norms that restrict women's mobility and decision-making authority, and economic constraints that disproportionately affect women, ultimately diminishing their resilience. Bagagnan, et al., (2019), employing the Motivation Theory, found that access to CIS positively influenced farmers' adaptation decisions in The Gambia, further affirming the importance of these services in promoting climate resilience.

While studies such as those by Kayusi et al., (2024) and Damba et al., (2022) have explored the relevance of CIS in enhancing African agricultural systems and farmer resilience, there is a notable gap in providing robust statistical evidence on the effectiveness of CSA communication and education dissemination channels in mitigating extreme climate shocks, such as floods and droughts. Moreover, these studies paid limited attention to the role of CSA communication and education as adaptation strategies for coping with climate change. In The Gambia, research on CSA communication and education remains particularly scarce, despite their potential to significantly improve farmers' resilience against climate extremes.

At the continental level, several policies and programs have been implemented to address the increasing frequency and severity of climate-related disasters. These include the African Green Stimulus Programme (2022), the African Union (AU) Climate Change and Resilient Development Strategy and Action Plan (2022–2032), the Comprehensive Africa Agriculture Development Program (CAADP), and the AU's Agenda 2063: *The Africa We Want*. These initiatives emphasize the importance of systematically integrating climate change adaptation measures into agricultural planning and policy to enhance farmers' resilience to climate extremes (Tadesse & Barry, 2024).

### **2.3.5 CSA communication and education initiatives and the different impact on men's and women's adoption of CSA practices**

Effective communication channels for Climate-Smart Agriculture (CSA) play a pivotal role in the adoption of CSAPs among men and women within the same household. According to Ngigi & Muange, (2022), access to Climate Information Systems (CIS) significantly increases the adoption rate of CSA technologies among both male and female farmers. The study also highlighted a gender disparity, with husbands having greater access to early warning systems, particularly those addressing droughts and floods, and receiving more advisory services for climate change adaptation compared to their wives.

Certain CSA technologies unintentionally impede adoption among women due to physical and cultural barriers that extend beyond agricultural needs. For instance, an irrigation scheme employing treadle pumps in Chikwawa, Malawi, was rejected by married women. The physically strenuous nature of the pumping left them too fatigued to fulfill household duties, which sometimes led to domestic conflicts. Additionally, the up-and-down pumping motion was culturally deemed inappropriate, as women wearing traditional 'chitenge' garments believed it exposed their legs, violating social norms (Khoza et al., 2021).

Gender inequalities in access to resources and decision-making power further exacerbate the challenges faced by women in adopting CSAPs. Huyer, (2021) investigated the vulnerability, resilience, and adoption of CSAPs across nine East and West African countries. The study revealed that women have less access than men to common property resources, financial means, and secure land tenure. Women typically control smaller plots of land, which are often of poorer quality, and their tenure arrangements are frequently insecure. To mitigate these disadvantages, women engage in social insurance networks and rely on non-agricultural support services provided by external organizations, which indirectly contribute to the development of CSAPs.

The gender gap in agricultural productivity is not due to population size but rather disparities in access to resources, inputs, and decision-making authority. Women face significant barriers, including limited access to agricultural inputs, technologies, agro-climatic information, financial resources, and labour. Cultural norms further restrict their participation in household and cooperative decision-making processes, as well as their involvement in community organizations. These norms often inhibit the adoption of innovative agricultural technologies (Boudalia et al., 2024; Waroga, 2019).

Addressing these structural and cultural barriers is essential to promoting equitable access to CSA technologies. Empowering women through targeted interventions, such as enhancing access to resources, improving information dissemination, and challenging restrictive cultural norms, will be critical in achieving the widespread adoption of CSAPs and fostering sustainable agricultural development.

### **2.3.6 Climate Change Impacts on Agriculture: The Need for CSA Integration into Policies**

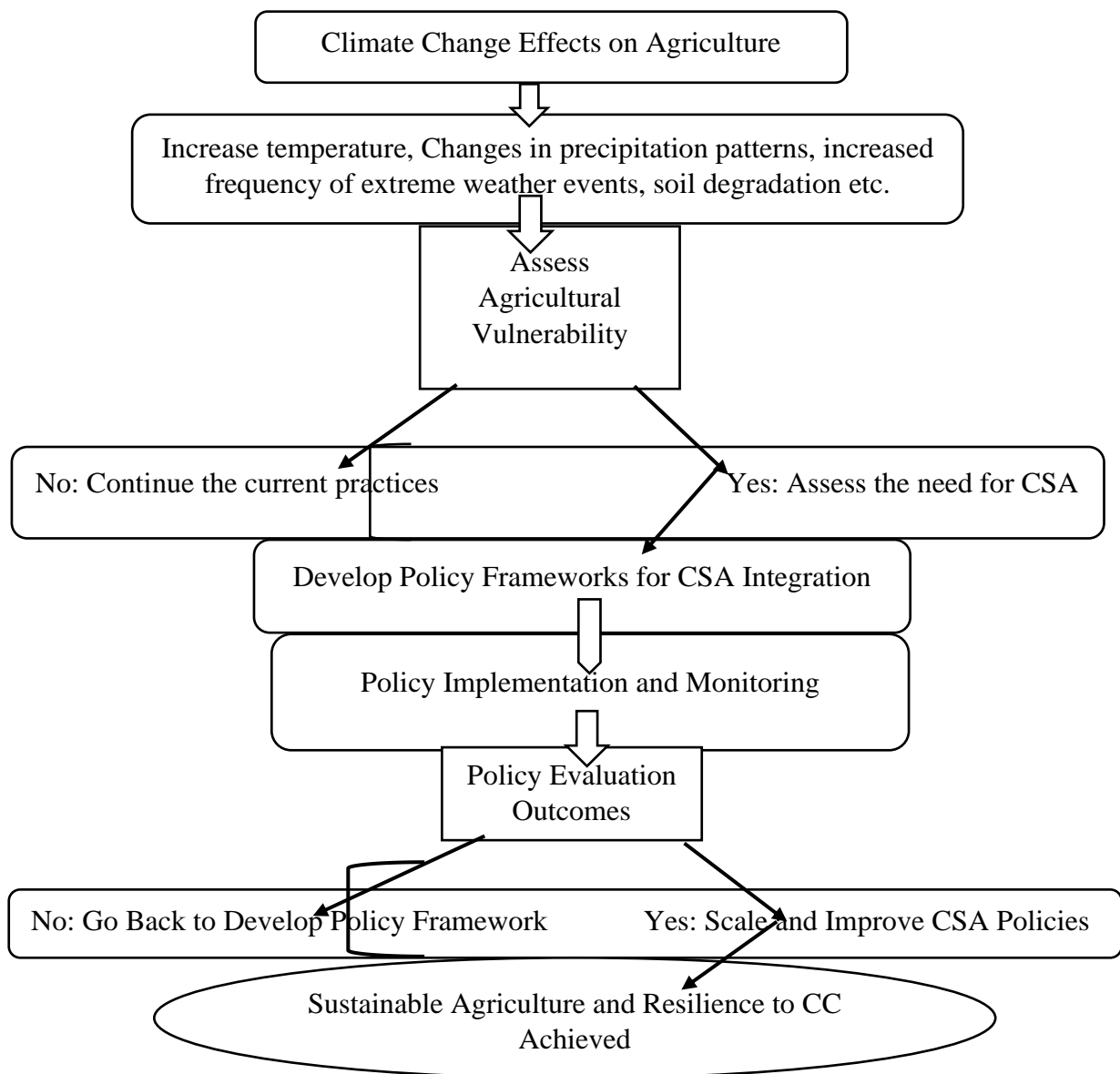
The health of plants and animals is impacted by climate change, which substantially affects agricultural systems. Changes in precipitation and rising temperatures, particularly in the frequency of exceptionally hot days, are the primary climatic factors influencing agriculture in Africa (Pereira, 2017). Due to their limited ability to adapt, many African nations are already experiencing a variety of climate-related stresses, such as droughts, floods, unpredictable rainfall, etc., which makes them extremely sensitive to climate change (Asafu-Adjaye, 2014). There are strong signs that the negative effects will disproportionately affect developing nations. This is mostly due to the developing world's high poverty rates, high vulnerability, and inadequate capacity for adaptation. Also, because agriculture is directly exposed to climate change, the rural inhabitants of developing countries, for whom agricultural output is the primary source of both direct and indirect employment and income, will be severely affected (Ringler et al., 2010).

Furthermore, several climate projections for West Africa's future show unfavourable effects that, in the absence of sustainable solutions, are expected to cause productivity crises. West Africa's primary agricultural production depends on rainfall, making the region susceptible to climate change. This has resulted in erratic rainfall patterns and prolonged high temperatures during the previous few decades (Zougmore et al., 2016). Future crop production uncertainty will affect the food system in West Africa, which in turn affects sociocultural, health, and economic systems. To prepare the food system for upcoming difficulties and to inform adaptation planning, it is vital to forecast possible changes in crop production under various climatic and field management scenarios (Carr et al., 2024).

In the Gambia, in addition to the long-standing issues of land degradation, inadequate drainage on farms, and improper fertilizer application, climate change and increased climate variability are currently perceived as significant threats to agricultural production, especially from the perspective of rice farmers in the CRR. The Central River Region in both the north and south of the Gambia, particularly rice farming, has long been rooted in customs and traditions since

it gives small-scale farmers a source of jobs, income, and food (Segnon et al., 2022). According to Badjie et al., (2019), as rural farmers in the Gambia rely on agriculture to provide food, climate change variability poses a significant threat to the production of cereal crops and rural livelihoods. Temperature and precipitation have a direct impact on crop yield. The amount of soil moisture and the availability of freshwater, two essential inputs for crop growth, are also determined by precipitation.

Even while CSA has a lot to offer for West Africa in particular, there are a lot of obstacles on its way. Notable among these are the following: farmers, policymakers, and potential investors do not have a clear understanding of the concept of climate-smart agriculture (CSA); farmers, and policymakers, can package technologies supporting CSA practices appropriately for farmers by managing trade-offs. West African agro-ecological regions are marginal, necessitating research on the biophysical adaptation of CSA practices throughout the region; institutional arrangements to upscale CSA from the farm scale to the landscape and national levels; limited technological capabilities and human resources competence; CSA must be integrated into the existing policy frameworks; and the creation and execution of successful risk-sharing programs (Zougmore et al., 2016). Knowing what climate-smart is in various places and creating initiatives that fit the implementation context is necessary for implementing CSA. When it comes to labour availability, for example, what works for one kind of farmer might not work for another, and a CSA strategy that produces positive results in one area would not necessarily produce positive results in another. A basic grasp of the environment in which CSA programs, policies, and initiatives will be implemented is required before any decisions can be made. This contains details about the farming operations as well as the stakeholders' objectives, limitations, and methods of subsistence. In addition to discussing the risks and effects of climate change, a CSA situation analysis should cover the agricultural, political, social, and economic backdrop of the region where CSA measures are being implemented. Effective program implementation, stakeholder participation and engagement, and appropriate monitoring and evaluation of African CSA programs are also necessary (Girvetz et al., 2017).



**Figure 2.5** schematic illustrating the impacts of CC on agriculture and how to integrate CSA into policy frameworks for sustainable farming.

Source: Authors computation from the literature

### 2.3.7 Limitations of Previous Studies

Many studies have explored Climate-Smart Agricultural Practices (CSAPs) in various contexts, but significant gaps remain. For instance, research by (Sonko et al.,2020) has explored studies on farmer knowledge and awareness and adoption rates of CSAPs in the Central River Region of the Gambia but does not include aspects of CSA information dissemination channels to help achieve greater farmer awareness. Studies by (Kutir et al.,2015) on farmer awareness and responses to climate change (CC) in the North Bank Region (NBR), explored the farmers

preferred channels of information dissemination but the study was not focused on CSA specifically, and it was not done in the CRR. Additionally, the socioeconomic and gendered factors that hinder farmers' access to information were also not explored in this study.

Although some studies have been done on CSA communication in Africa, such examples are those by Ngigi and Muange (2022) have shown the importance of tailored communication in increasing adoption but lack specificity for the Gambian context. It also fails to deeply examine the socio-economic, cultural, and infrastructural factors unique to The Gambia, especially the Central River Region (CRR) which is considered the country's food basket. Studies such as those by Barasa et al. (2021) and Moutouama et al. (2022) focused on broader trends but lacked the nuanced understanding required to address specific local challenges faced by most smallholder farmers in Africa regarding CSA adoption.

Furthermore, the effectiveness of communication channels and education strategies for disseminating CSA information remains underexplored. Similarly, the impact of CSA communication on resilience to climate extremes, such as droughts and floods, is often mentioned but rarely supported by robust statistical evidence. This underscores the need for comprehensive, localized research in the integration of CSA communication in the CRR.

Gender and socio-economic disparities have also been inadequately addressed in prior studies. While many researchers recognize that women face unique barriers to adopting CSA technologies, there is a lack of gender-specific analysis focusing on how cultural norms, access to resources, and decision-making power affect adoption rates.

### **2.3.8 Value Addition of the Study**

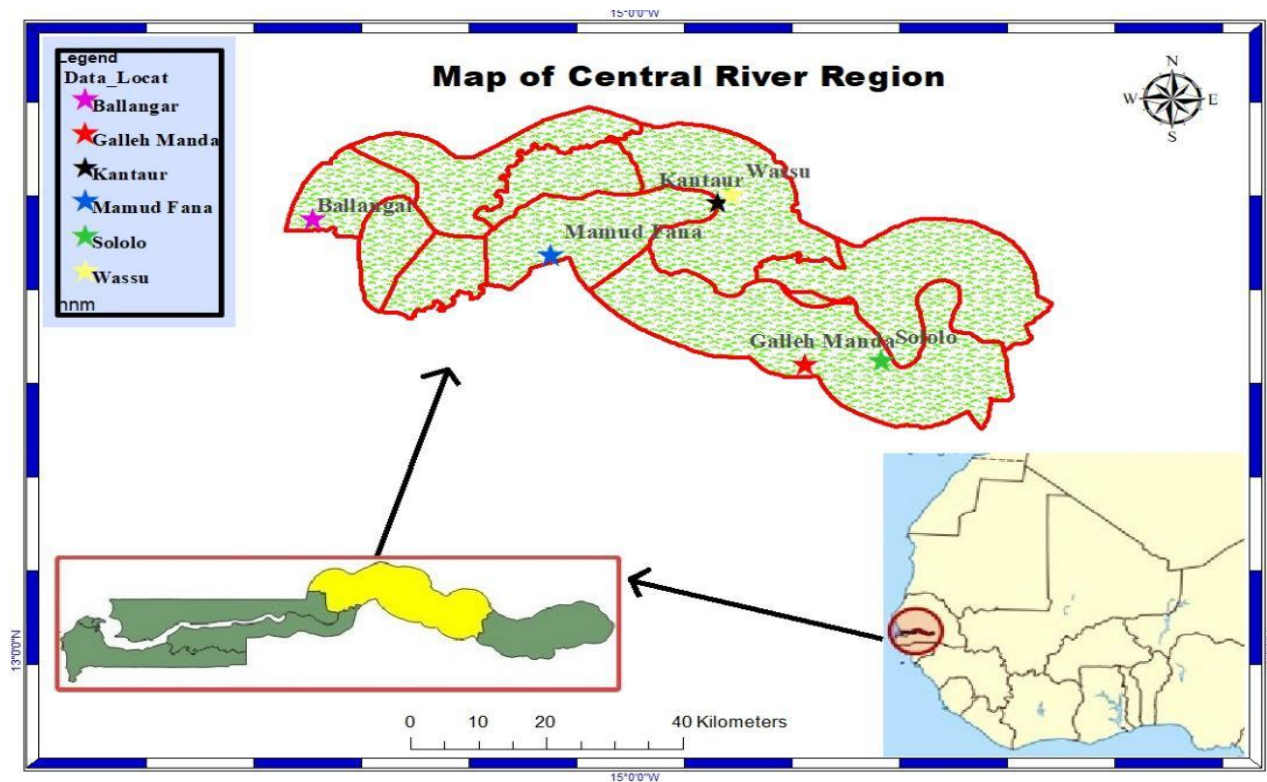
The study provides significant insights that further pushed research on CSA communication and education, especially in the context of the Central River Region CRR in The Gambia. Beyond generic studies of climate change in sub-Saharan Africa, this research focuses on CSA education and communication to increase the climate shock and extreme resilience of smallholder farmers. This study employs evidence to identify the most effective CSA communication routes, demonstrating how farmers should be informed according to their socioeconomic status, gender barriers, and literacy levels. Farmers receive useful climate data through tailored programming, which increases their adoption of and adherence to CSA principles.

The addition of gender concerns during CSA adoption research adds value to the study. Although they typically face institutional barriers related to agricultural education and financing, as well as exclusive property rights, women who labour in the CRR make a substantial contribution to smallholder agriculture. According to research, such as those by Ngigi & Muange, (2022) and Mogaka et al., (2021) men and women approach Climate-Smart Agriculture knowledge differently, which offers fresh approaches to improving communication tactics that can do away with these gender-based disparities. Since CSA improvements will benefit both male and female farmers, the research explores gender-specific hurdles to offer well-informed recommendations that help ensure agricultural growth becomes inclusive.

By mixing quantitative and qualitative approaches through surveys, focus groups, and key informant interviews with farmers, extension agents, and policymakers, this study's research methodology sets itself apart from others. A thorough grasp of the CSA's obstacles to agricultural education and communication, as well as potential growth prospects, is produced by a comprehensive data-collecting structure. The findings of this study serve as a model for other endangered agricultural regions and aid in the development of agricultural policy at the local and national levels. To create sustainable agricultural systems that improve food security, environmental sustainability, and economic resilience in The Gambia and around the world, policy frameworks must incorporate CSA communication techniques and educational practices

## CHAPTER THREE MATERIALS AND METHODS

### 3.1 Study Area



**Figure 3.1** Map of the Central River Region indicating the specific communities where the study was carried out

The study was conducted in The Gambia's Central River Region, with Janjanbureh as its administrative center. Located roughly 200 km from Banjul, the Central River Region is said to be the largest of all the administrative divisions in the Gambia. Its capital is Janjanbureh (formerly Georgetown) located at coordinates 13°34'N and 14°47'W. The local population primarily relies on agriculture, particularly the production of a variety of crops such as rice, maize, peanuts, millet, cassava, beans, and sorghum. Mandinka, Wolof, and Fula form the majority of all the other tribes and are the main languages spoken in the area. The Region experiences two distinct seasons: the dry and the wet season (Drammeh et al., 2020).

It covers an area of 2,894.3 km<sup>2</sup> with a population density of 78 inhabitants per km<sup>2</sup>. It comprises ten local administrative districts, namely, Fulladu West, Janjanbureh, Lower Saloum, Niamina Dankunku, Niamina East, Niamina West, Niani, Nianija, Sami, and Upper Fulladu, each governed by a District Chief, known as Seyfo. It has subsequently been divided into two Local Government Areas (Janjanbureh in the south and Kuntaur in the north), each containing five of

the above-mentioned districts (Ali Bah, 2019). According to the 2013 census, the region had a population of 226,018 residents (Census, 2013).

As the home to two of the country's pioneering agricultural training centers, located in Fula Bantang and Sapu, the Central River Region which spans both sides of the River Gambia, features a diverse landscape, ranging from lush rainforests to fertile agricultural lands. This makes the area an important hub for both agricultural production and biodiversity conservation in the country (Bagagnan et al., 2019).

The region was purposively selected for the study due to its significant exposure and vulnerability to climate change and variability. Moreover, farmers in the area have limited access to communication and education on Climate-Smart Agriculture (CSA). Additionally, The Gambia's Food System Profile report (2022), noted that the region has the highest levels of food insecurity, ranging from 24.1% to 29.8% (*Food Systems Profile - The Gambia, 2022*). This situation is further exacerbated by the changing climate, coupled with smallholder farmers' limited knowledge and understanding of CSA.

The region stands out for its fertile soil and rich vegetation, especially in comparison to other parts of the country. Given that the majority of the population in this region depends on agriculture, any reduction or failure in crop yields poses a serious threat to food security in the area.

### **3.2 Target Population**

The study focuses on smallholder farmers in the Central River Region of The Gambia, which has a population of 226,018 people according to the 2013 population and housing census of the Gambia (Census, 2013). These formed the accessible respondents for the study.

### **3.3 Community Visits**

To obtain a social license to administer validated questionnaires, we first contacted the extension officer designated within the study areas, who then connected us to the village head, also known as "Alkalos" for all the selected communities. This was then followed by meetings held in each of the communities under the authority of the "Alkalos" together with other leaders such as imams, community elders, and Village Development Committee (VDC) members. Following all the aforementioned protocols, we were later allowed to administer our questionnaires.

### 3.4 Sampling Technique and Sample Size

Six communities were randomly selected for the study across the ten districts in the region. Smallholder farmers were randomly selected from the list of farmers provided by the extension workers in each of the communities.

A multi-stage sample strategy was used to gather comprehensive data on the efficient dissemination of climate-smart agriculture communication and education to smallholder farmers in the selected communities.

To the best of our knowledge since there was no data available on the proportion of farmers who are aware of CSA in The Gambia, we therefore deemed it necessary to conduct a pilot study to determine the proportion of farmers in CRR who are aware about CSA. This study revealed that 80% of respondents were aware of Climate-Smart Agriculture.

The formula by Cochran (1977) shown below was used to estimate the sample size:

$$n = \frac{Z^2 \times P(1-P)}{\epsilon^2}$$

Where:

n = sample size;

Z = normal curve distribution (1.96 which corresponds to a 95% confidence interval);

p = proportion of farmers derived from the pilot study that know about Climate-Smart Agriculture (given as 0.8 when the exact proportion of the farmers is not known), and

ε = margin of error is set at 95% (given as 0.05).

Based on this, an initial sample size of 246 participants was determined and then increased by 10% to account for sampling error, resulting in a final total of 273 respondents.

In the first stage, the ten districts in the region were all considered for this study. In the second stage, six communities were randomly chosen out of the ten regional districts. In the third stage, 40 smallholder farmers were randomly chosen from each of the three selected communities in the north while in the south, 51 smallholder farmers were also chosen from each community selected for the study, making a total of 273 smallholder farmers.

The sample was distributed across the two sub-regions based on population data from the 2013 Gambia Bureau of Statistics (GBoS) census. CRR North, with a population of 98,966,

contributed 120 participants, while CRR South, with a population of 127,333, provided 153 participants. Accordingly, the 120 questionnaires for CRR North were distributed evenly across the three communities, with 40 questionnaires per community. The same approach was applied in CRR South, resulting in 51 questionnaires per community.

To identify the eligible participants, a comprehensive list of smallholder farmers was obtained from the extension officers serving the region. From this list, 273 smallholder farmers were randomly selected for evaluation. Eligibility criteria included being an active smallholder farmer over 18 years of age, residing in the selected communities, and possessing the ability to communicate effectively.

### **3.5 Data Collection**

#### **3.5.1 Validity of Questionnaires**

Validity refers to the extent to which the questionnaire accurately measures what it is intended to measure. In other words, it ensures that the measurement aligns with what it is supposed to assess (Taherdoost, 2016). To ensure the validity of the questionnaire, both the supervisor and co-supervisor conducted a thorough review of the data collection instrument to determine whether the items could measure the study objectives as stated. In addition, a peer review by my colleagues and other visiting professors at the Pan African University Institute for Water and Energy Sciences (Inc. Climate Change), PAUWES, was done specifically to check the clarity, font size, and overall language of the instrument. After supervisors and others checked the instrument, corrections were later made and the instrument was finalized.

#### **3.5.2 Reliability**

According to Bolarinwa, (2015), reliability refers to the consistency of results obtained through a measurement or procedure when repeated. While reliability plays a crucial role in ensuring the validity of a questionnaire, it alone does not guarantee validity. In the quest to enhance the reliability of the data collection tool, pilot studies were carried out in which a questionnaire was administered to 25 smallholder farmers who were randomly selected from a list of farmers in the Sukuta model horticultural garden in the West Coast Region of the Gambia.

This study had 273 structured, pre-tested, and validated questionnaires. Smallholder farmers in each of the communities chosen for the study in the CRR South received 51 questionnaires, while communities in the North received 40 questionnaires each—all of which were well-structured, validated and pre-tested.

### **3.5.3 Focus Group Discussions**

Focus Group Discussions (FGDs) were conducted in three of the six randomly selected villages. These discussions were labeled FGD 1, FGD 2, and FGD 3, respectively. The FGDs included participants from all age groups, including young people, women, and the elderly. A generalized mixed-population approach was used to ensure diverse representation. Community leaders, women, young people, and members of farmer associations took part in the discussions, fostering a participatory approach to data collection and providing valuable insights into the differing perspectives of farmers.

Participants for the FGD were selected based on key criteria, including being smallholder farmers, be at least 18 years or above, and residing in the community under study for at least one year.

#### **FGD 1:**

The first FGD was held in Kuntaur Village in the CRR to understand local insights about CSA and how it is communicated via different channels. The session brought together women and led farmers across the community to achieve a broad intersection of participants. Several issues that are in line with the study objectives were discussed. This includes but not limited to farmer challenges stemming from climate change and variability and how it has impacted farming in the region, smallholder farmers' perception of CSA, current CSA practices in the region, forms training received, and effective CSA information access and education by farmers for an improved resilience amongst others. The meeting offered participants an opportunity to describe how the challenges above have affected their farming practices and suggest solutions. Furthermore, the interaction has helped us gather valuable insights, knowledge gaps, and CSA training needs of smallholder farmers while emphasizing the need to integrate CSA communication and education for a sustainable agricultural system.



**Figure 3.2** FGD 1 with farmers in the Kuntaur village, CRR

Source: Author

**FGD 2:**

The participants of the second Focus Group Discussion gathered at Wassu rice fields in the CRR where smallholder rice farmers held an insightful discussion. The session analyzed detailed rice farming challenges regarding climate change adaptation such as erratic rainfall together with flooding conditions and declining soil fertility. Local farmers reported their encounters with extreme weather conditions such as flooding and drought. The researcher was able to see the various impacts of flooding on the rice which has caused a lot of destruction to crops. Participants discussed how education combined with communication can help to eliminate the existing knowledge gaps among farmers who try to implement climate-smart agricultural methods. Several talks were made concerning the matter under study to help improve smallholder farmers' resilience and achieve sustainable farming.



**Figure 3.3** FGD with rice farmers in Wassu, CRR

Source: Author

### **FGD 3**

Community elders from Ballanghar participated in the third FGD because they have been severely impacted by climate change impacts especially salt intrusion along their rice fields. The session delivered valuable historical information regarding weather pattern transformations and soil condition shifts along with water resource changes which gave a deep historical view of agricultural climate change impacts on CRR.

Elders who participated in the discussion explained how salt intrusion is affecting their household food security placed special emphasis on the negative effects of hippopotamus on the rice fields and called for concerned authorities. The elderly participants exhibited a substantial eagerness to join forces with agricultural experts as well as policymakers to develop customized solutions because they want sustainable farming practices to persist with advanced methods into future generations.



**Figure 3.4** FGD 2 with community leaders in Ballanghar village, CRR

Source: Author

### **3.6 Key Informant Interview**

Interviews with a few key agriculture stakeholders were undertaken as part of the data collection process. This includes the Regional Agricultural Directorate officials, CRR, Communication, Education and Extension Services (CEES), extension workers, VDC members, village heads, Heads of farmer associations, and officials of NGOs operating in the region. There were eight KIIs labelled as KII 1-8.

**Table 3.1: Key informants consulted in the study**

<b>Institutions/Stakeholders</b>	<b>Key Informant</b>	<b>Gender</b>	<b>Experience</b>	<b>Interviews</b>
Regional Agricultural Directorate-CRR	Extension workers	1 male, 1 female	5 years	2
Communication, Education, and Extension Services	Director	Male	>10 years	1
ActionAid International, The Gambia (NGO)	Regional Director	Female	>5 years	1
Village Development Committee, Sololo	Chairman	Male	>5 years	1
‘Senela kafoo’, ‘Wassu Kankiling, and ‘Group jubo’	Presidents	All female	>5 years	3

### 3.7.1 Data Analysis

The quantitative data acquired was systematically arranged and encoded, taking into account the important variables entered into IBM SPSS version 27. IBM SPSS, and Microsoft Excel, were utilized for the descriptive analysis (frequencies, pie charts, and percentages). Multiple regression analysis was conducted using Stata version 18. The results were analyzed using descriptive statistics, which are presented in tables and charts. Chi-square tests were conducted to determine the associations between selected sociodemographic variables and smallholder farmers' perceptions of CSA practices in the CRR. The same approach was applied to assess the relationship between sociodemographic factors and smallholder farmers' access to CSA information. The differential impact of the CSA communication and education initiatives on the behaviours of women and men, adoption of CSA Practices, and the socioeconomic factors that hinder farmers' access to CSA communication and education were realized using multiple regression analysis. Qualitative data were all analyzed using thematic content analysis.

### 3.7.2 Multiple Linear Regression Showing the Relationship between Socioeconomic Factors and Smallholder Farmers' Access to CSA information

We employed a multiple linear regression model to examine the relationship between farmers' access to climate-smart agriculture (CSA) information and key socioeconomic variables. This model analyzes the relationship between a single dependent variable, the response variable, and multiple independent variables, referred to as explanatory or exogenous variables. These variables all measured the goodness of fit or accuracy of the estimates of the model, especially the R-squared, which is called the coefficient of determination, which is the proportion of how much the independent variables in the model explain the total variance. We also have other tests like F- F-statistic, t-ratios, and p-values to test the hypothesis and indicate the rejection region in the model with degrees of freedom.

In our study, the dependent variable is access to climate-smart agriculture information, while the independent variables include gender, marital status, educational level, age, main occupation, household income, land ownership, airtime affordability, social status, and access to extension workers.

Therefore, if  $y$  is a dependent variable and  $x_1, \dots, x_k$  are independent variables and  $e_i$  is the stochastic error term, then the multiple regression model provides a prediction or forecasting of  $y$  given  $x_i$  of the form:

$$y_i = b_0 + b_1 x_{1i} + b_2 x_{2i} + \dots + b_p x_{pi} + e_i$$

where the assumption on the error terms is exactly as in simple linear regression, to estimate the coefficients and se (standard error of the estimate), one follows a process very similar to that observed in the case of only one predictor value. The left-hand side variable is the dependent variable, and the right-hand side variables are the independent variables.

#### Model Specifications

$$CSA_i = F(HHI_i, LOS_i, AFFORB_i, ATEW_i, SS_i, AT_i, Z_i)$$

Where:

HHI<sub>i</sub>: **Household Income**\_ Indicate your monthly household income from your major occupation

LOS<sub>i</sub>: **Land Ownership** \_Land Ownership

AFFORB<sub>i</sub>: **AFFORDABILITY**-How affordable are the communication tools for CSA

ATEW<sub>i</sub>: **Access to Ex. Workers**\_ Do you have access to extension workers

SS<sub>i</sub>: **Social Status**\_ Does your social status in your community impact your access to CSA information

AT<sub>i</sub>: **Airtime**\_ How much does your household spend on airtime

Z<sub>i</sub>: Other control variables like **Gender; Marital Status; HHSIZE, EDUCATIONAL LEVEL; Major Occupation**

ε<sub>i</sub> = error term at time t

*i; means individual i e.g; regions, country, district, village etc.*

Multiple linear regression model between CSA information, household income, land ownership, affordability, access to extension worker, social status, Airtime, and other control variables is as follows:

$$CSA_i = \gamma_0 + \gamma_1 HHI_i + \gamma_2 LOS_i + \gamma_3 AFFORB_i + \gamma_4 ATEW_i + \gamma_5 SS_i + \gamma_6 AT_i + \gamma_7 Z_i + \epsilon_i$$

### 3.7.3 Multiple Linear Regression on CSA Adoption Rate by Gender in the CRR

To establish the connections between the CSA adoption rate and how different gender factors influence it, we further conducted an MLR. The dependent variable that was used in the analysis was 'who makes decisions concerning CSA adoption in your household' and the independent variables were: gender-based barrier, CSA program participation by men vs women, CSA support from extension workers, access to CSA communication tools by gender, and CSA training based on gender needs.

Thus, if y is a dependent variable and x<sub>1</sub>, ..., x<sub>k</sub> are independent variables, then the multiple regression model provides a prediction or forecasting of y given x<sub>i</sub> of the form:

$$y_i = b_0 + b_1 x_{1i} + b_2 x_{2i} + \dots + b_p x_{pi} + e_i$$

where the assumption on the error terms is exactly as in simple linear regression, to estimate the coefficients and se (standard error of the estimate), one follows a process very similar to that observed in the case of only one predictor value. The left-hand side variable is the dependent variable, and the right-hand side is the independent variable.

The multiple linear regression model between CSA adoption and other gender factors is therefore represented as follows:

$$CSA_{A_i} = \gamma_0 + \gamma_1 CSAP\_MW + \gamma_2 GBB + \gamma_3 SFEW_i + \gamma_4 ATCSA\_COM + \gamma_5 CSA\_TOG_i + \varepsilon_i$$

Where:

**CSA P.P by men vs women (CSAP\_MW)** \_CSA Program Participation by men vs women

**Gender-Based Barriers (GBB)**\_Does Gender-Based Barriers limit access to CSA communication and education

**Sup. from Ex. Workers (SFEW)**\_Do both men and women receive equal support from Extension workers

**Access to CSA Comm. Tools (ATCSA\_COM)**\_Do both men and women have access to CSA communication tools

**CSA Training on Gender Needs (CSA\_TOG )**\_Are CSA training tailored for gender-specific needs

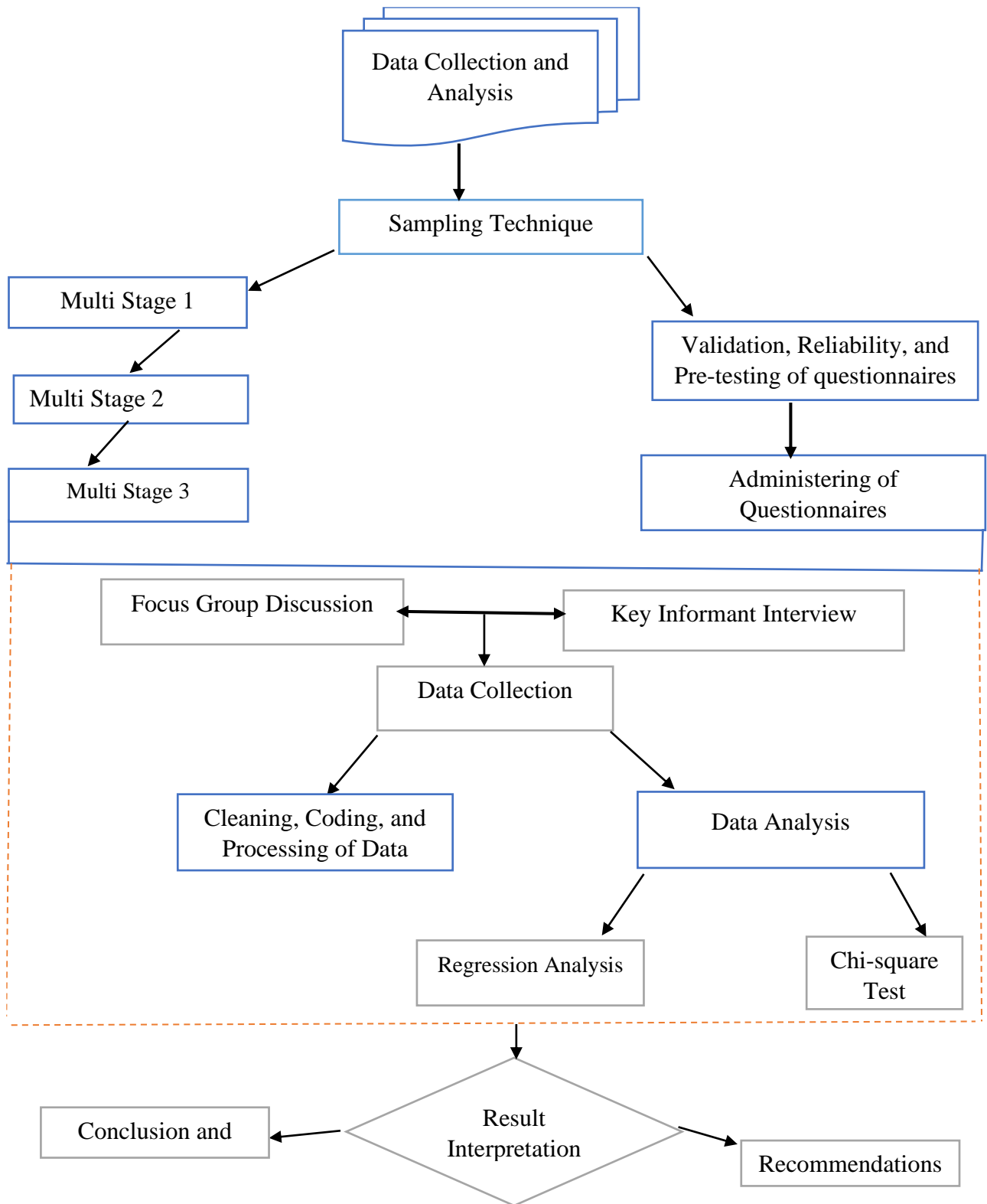
### **3.8 Inclusion and Exclusion Criteria**

#### **3.8.1 Inclusion Criteria**

This study was conducted only in the Central River Region of the Gambia, and farmers residing in the area and able to communicate well with the consent to participate were recruited and considered in this study.

#### **3.8.2 Exclusion Criteria**

Other regions and communities outside the CRR did not participate in this study and therefore, farmers in those other regions were not considered in the study.



**Figure 3.5** illustrates the flowchart of the study methodology

## CHAPTER 4 RESULTS AND DISCUSSIONS

### 4.0 Results

#### 4.1 Demographic variable

There were slightly more men than women in our study, 50.5% (138/273), the majority of them were married, 89.75 (245/273), and most of them had the informal madrassa education, 37.7% (103/273) (Table 4.1). Rice was the main crop grown, representing (39.2%) while maize was reported to be the least crop grown by smallholder farmers (3.3%) (Figure 4.1).

**Table 4.1: Sociodemographic Characteristics of Respondents**

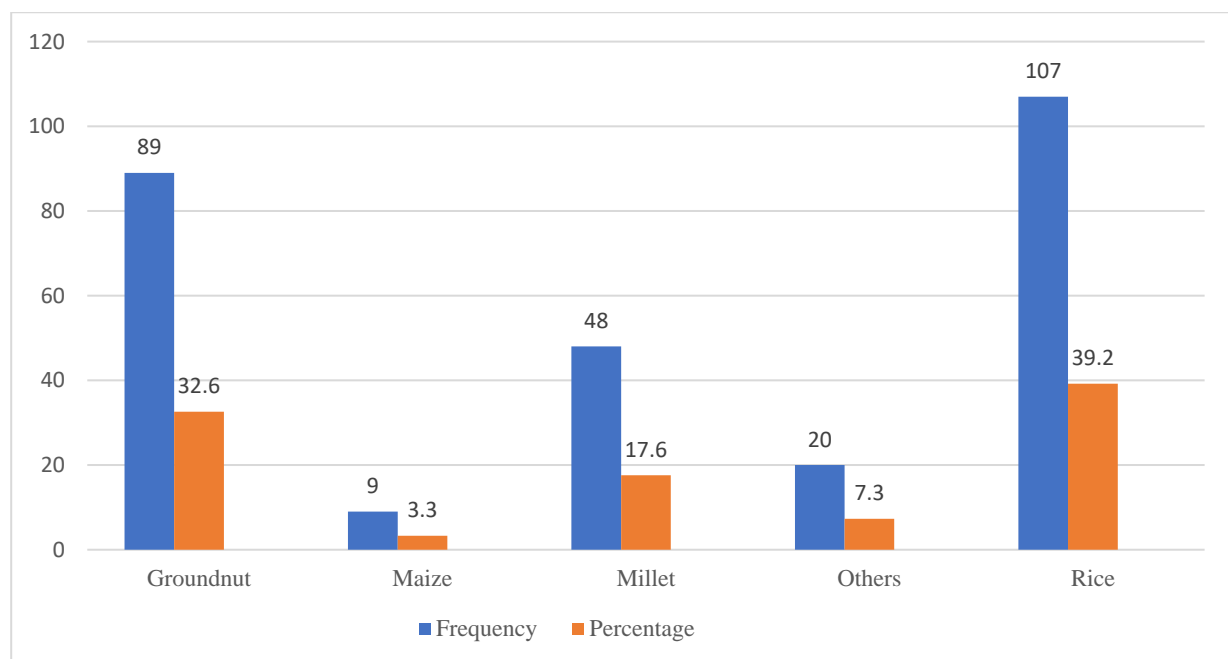
Variables	Frequency	Percentage
<b>Gender</b>		
Female	135	49.5
Male	138	50.5
<b>Marital Status</b>		
Divorce	17	6.2
Married	245	89.7
Separated	4	1.5
Single	2	0.7
Widowed	4	1.5
<b>Educational Level</b>		
Informal Madrassa	103	37.7
No Formal Education	97	35.5
Primary	31	11.4
Secondary	29	10.6

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Tertiary	13	4.8
<b>Age</b>		
>55	64	23.4
18_24	16	5.9
25_34	61	22.3
35_44	73	26.7
45_54	58	21.2
<b>Religion</b>		
Christianity	3	1.1
Islam	270	98.9
<b>Ethnicity</b>		
Fula	20	7.3
Jola	3	1.1
Mandinka	111	40.7
Wolof	128	46.9
Other	11	4.0
<b>Years Stayed in the Community</b>		
>15	224	82.1
1_5	6	2.2
10_14	32	11.7
6_10	11	4.0

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District		
Lower Saloum	45	16.5
Niamina East	33	12.1
Niani	106	38.8
Upper Fulladou	89	32.6

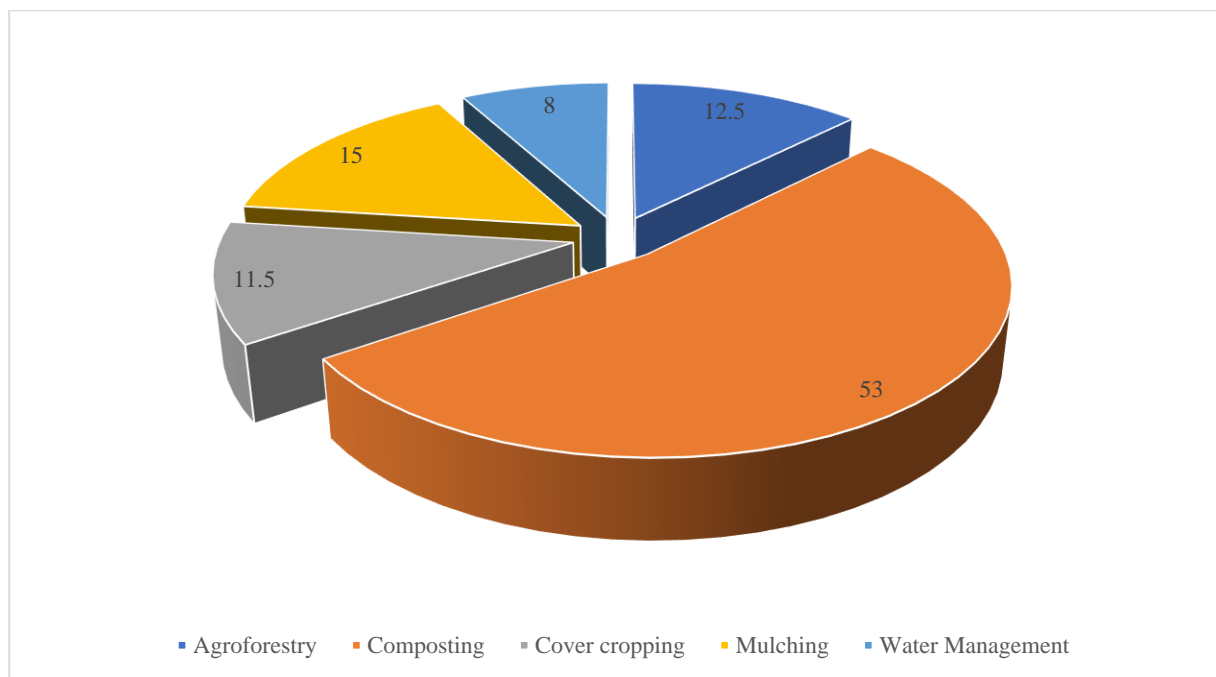


**Figure 4.1:** Types of main crops grown in the Central River Region

#### 4.2.1 Perception of Farmers on CSA

Regarding farmers' perception of CSA, more than half (53%) of the respondents reported they perceive CSA as compost-making (Figure 4.2). Furthermore, in Figure 4.3, (46.9%) of the respondents reported knowing compost-making. Additionally, the majority of the respondents (38.5%) noted that composting was the most frequent climate-smart agricultural practice (CSAP). While (54.2%) of the respondents also noted that they never received any form of CSA-related advice from Extension workers (Table 4.2).

Furthermore, a chi-square test revealed that gender ( $P = 0.038^*$ ) and household size ( $P < 0.001^{***}$ ) were the only demographic factors significantly influencing respondents' perceptions of CSA (Table 4.3).



**Figure 4.2** Perception of smallholder farmers about CSA in the CRR

**Table 4.2: Common CSA type and CSA related advice received from Extension workers**

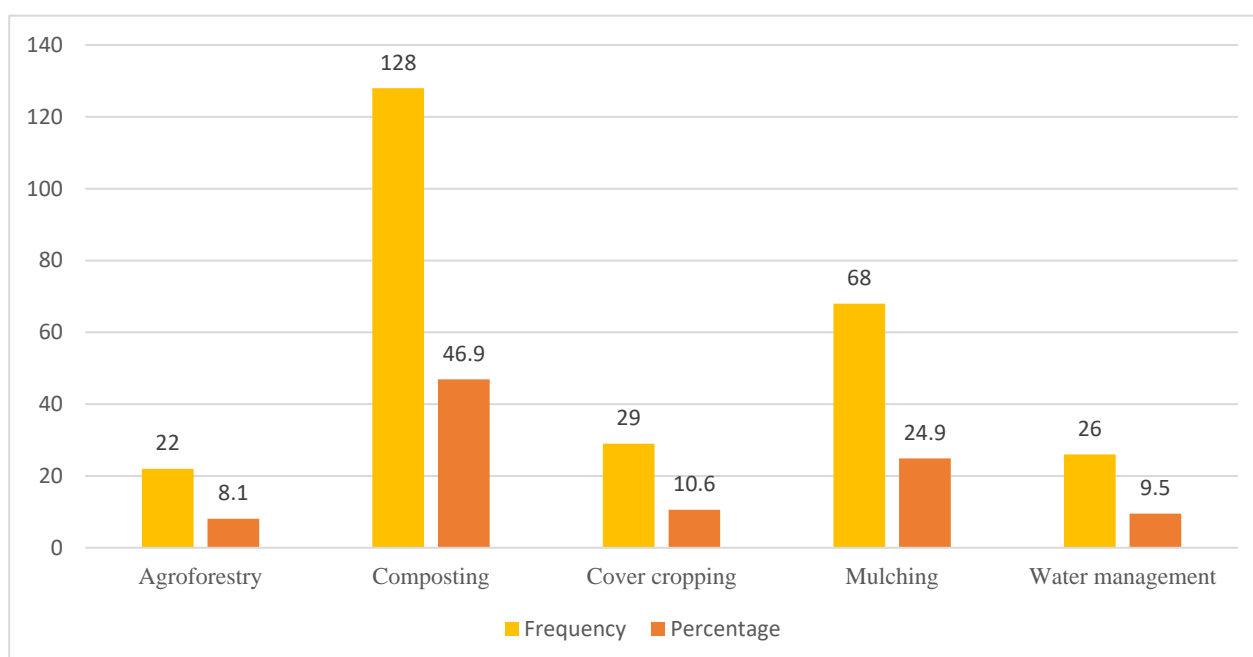
Variables	Frequency	Percentage
<b>CSA types that farmers mostly practice</b>		
Agroforestry	4	1.5
Composting	105	38.5
Cover Cropping	7	2.6
Mulching	10	3.7
Water management	3	1.1
<b>CSA-related advice received from Extension workers</b>		
No	148	54.2

Yes	124	45.4
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**Table 4.3: Association between sociodemographic variables and smallholder farmers' Perceptions of CSA practices in the CRR**

<b>Variables</b>	<b>Yes</b>	<b>No</b>	<b>X<sup>2</sup></b>	<b>P-Value</b>
<b>Gender</b>				
Male	79	56	0.069	0.038*
Female	65	73		
<b>Number of people in the household</b>				
>20	44	60	17.166	>0.001***
1_5	23	7		
11_14	12	20		
15_19	31	20		
6_10	34	22		
<b>Land Ownership</b>				
Communal Land	5	2	1.110	0.593
Leased	53	46		
Owned	86	81		
<b>Income from major occupation for the past year</b>				
>50000	11	7	5.579	0.366

10000_20000	30	41
21000_30000	13	12
31000_40000	6	3
41000_50000	3	1



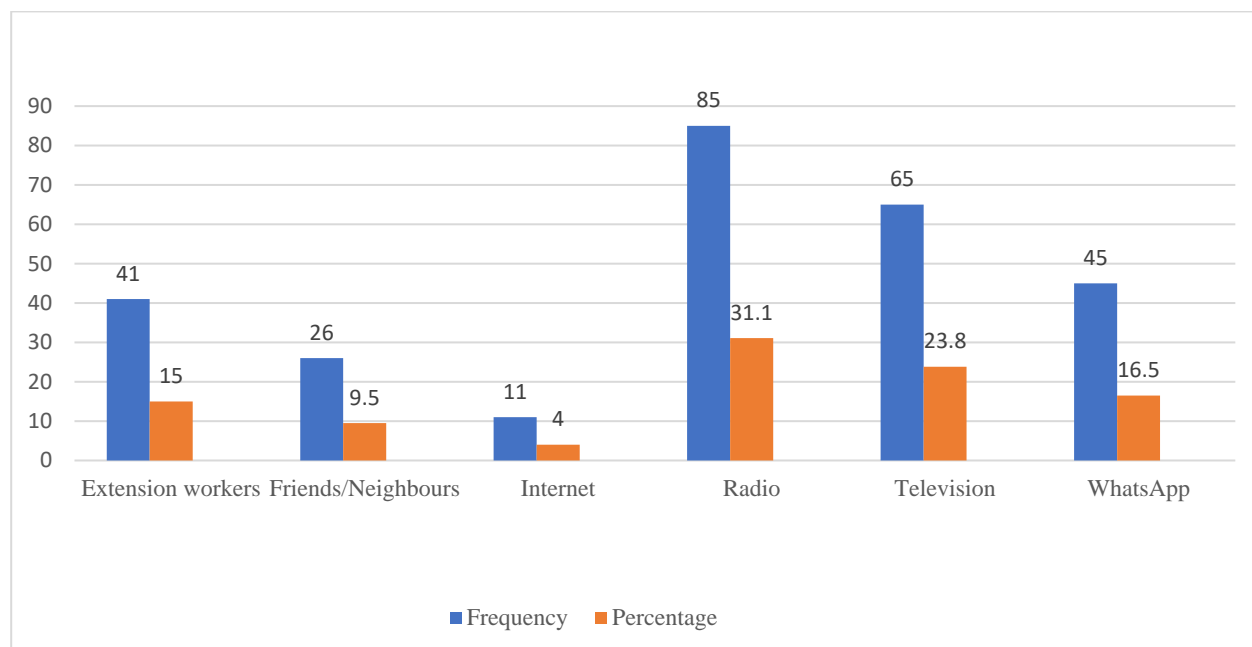
**Figure 4.3** Farmers' knowledge of different CSA practices

#### 4.2.2 Effectiveness of the different communication channels in disseminating CSA in CRR

Radios were cited as the most effective channels for the dissemination of CSA information (31.1%), while 4% of respondents cited the internet as an effective channel (Figure 4.4). Participants in our study reported daily radio usage at (22.7%), in contrast to its yearly accessibility, which stood at only (2.6%). A good proportion of respondents (23.1%) indicated they never used television, despite expressing a desire to own one. Regarding access to extension workers, 14.7% of respondents stated they had never received CSA information from these workers (Table 4.4).

Figure 4.5 revealed that the majority of respondents (36.6%) preferred television as their primary source of communication, while the internet ranked lowest, with only (2.2%). Additionally, most respondents (58.6%) identified the high cost of communication tools as the

primary barrier to accessing CSA information. Poor signal network coverage was also noted as a significant challenge by 27.5% of respondents (Figure 4.6). In terms of farmers' membership in organizations, (59%) of respondents reported not belonging to any farmer associations or cooperative societies (Figure 4.7).



**Figure 4.4** Effectiveness of different CSA communication channels

**Table 4.4: Frequency of CSA information Access through various communication channels**

Variables	Frequency	Percentage
<b>Radios</b>		
Daily	62	22.7
Monthly	11	4.0
Never_Accessed	31	11.4
Weekly	21	7.7
Yearly	7	2.6

**Television**

Daily	40	14.7
Monthly	6	2.2
Never_Accessed	63	23.1
Weekly	10	3.7
Yearly	11	4.0

**Extension workers**

Daily	9	3.3
Monthly	39	14.3
Never_Accessed	38	13.9
Weekly	15	5.5
Yearly	40	14.7

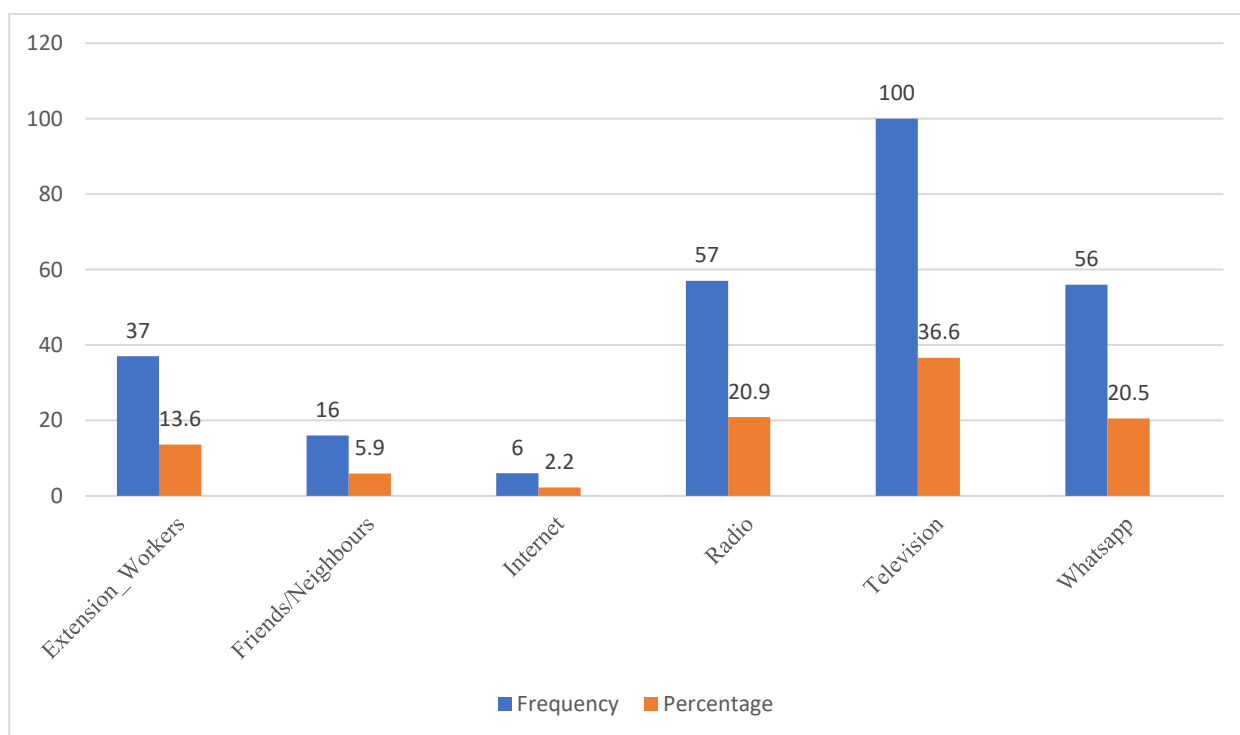
**WhatsApp**

Daily	50	18.3
Monthly	11	4.0
Never_Accessed	59	21.6
Weekly	11	4.0
Yearly	9	3.3

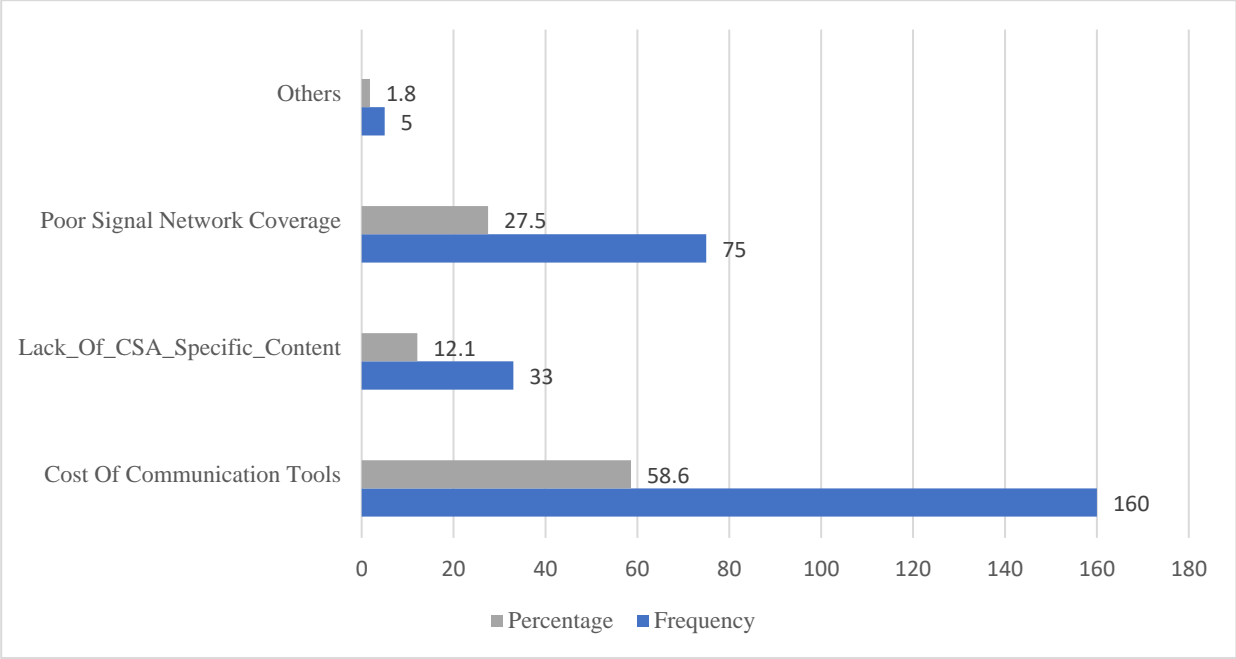
**Internet**

Daily	9	3.3
Monthly	6	2.2

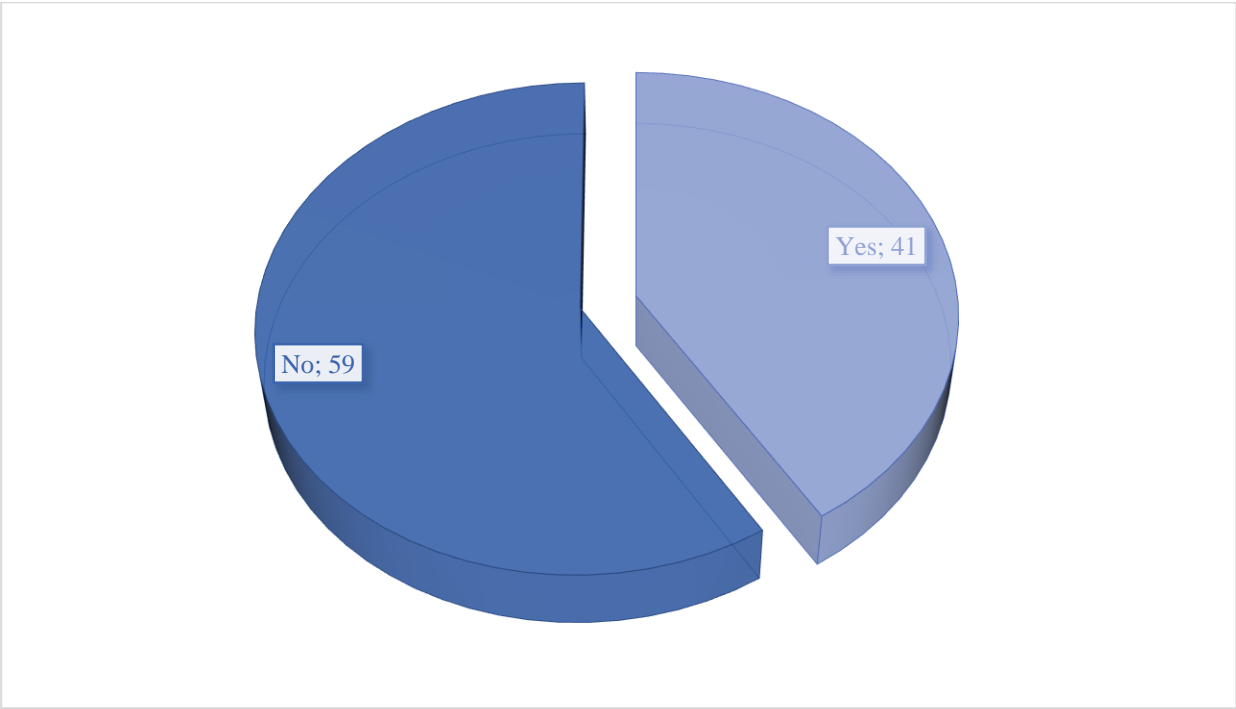
Never_Accessed	89	32.6
Weekly	6	2.2
Yearly	3	1.1
<b>Friends/Neighbours</b>		
Daily	68	24.9
Monthly	9	3.3
Never_Accessed	15	5.5
Weekly	26	9.5
Yearly	10	3.7



**Figure 4.5** Smallholder farmers' preferred method of CSA information dissemination



**Figure 4.6** Challenges faced by farmers in receiving CSA information in the CRR



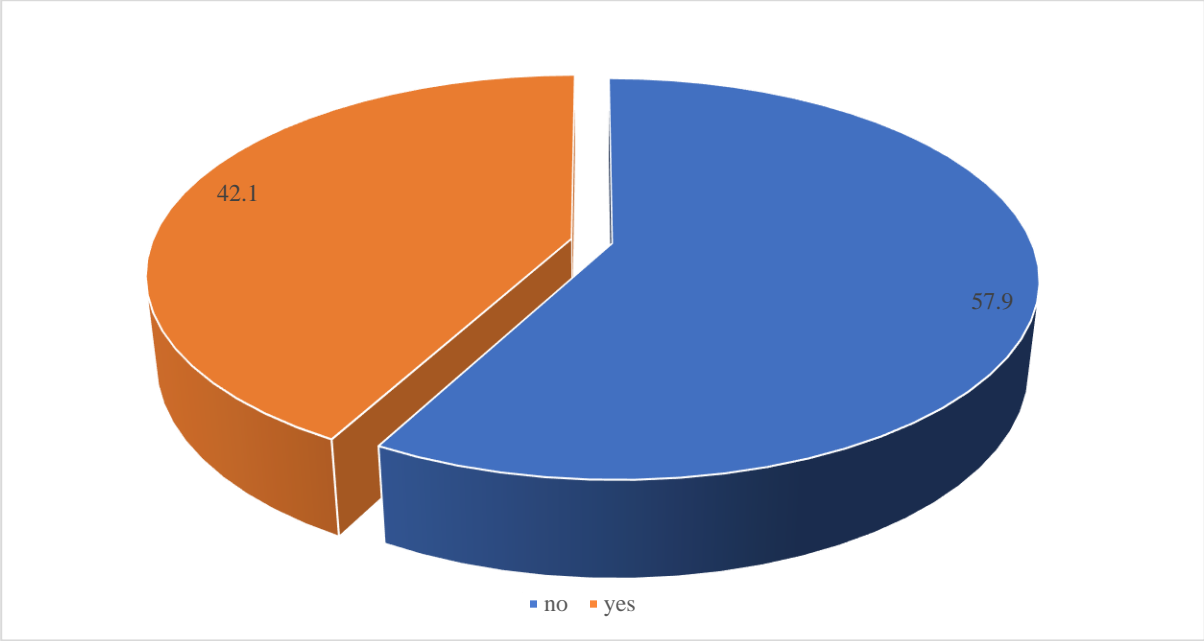
**Figure 4.7:** Smallholder farmers' membership in Different Cooperative Societies or Farmer Associations

### **4.3.1 Socioeconomic factors hindering farmers' access to CSA communication and education**

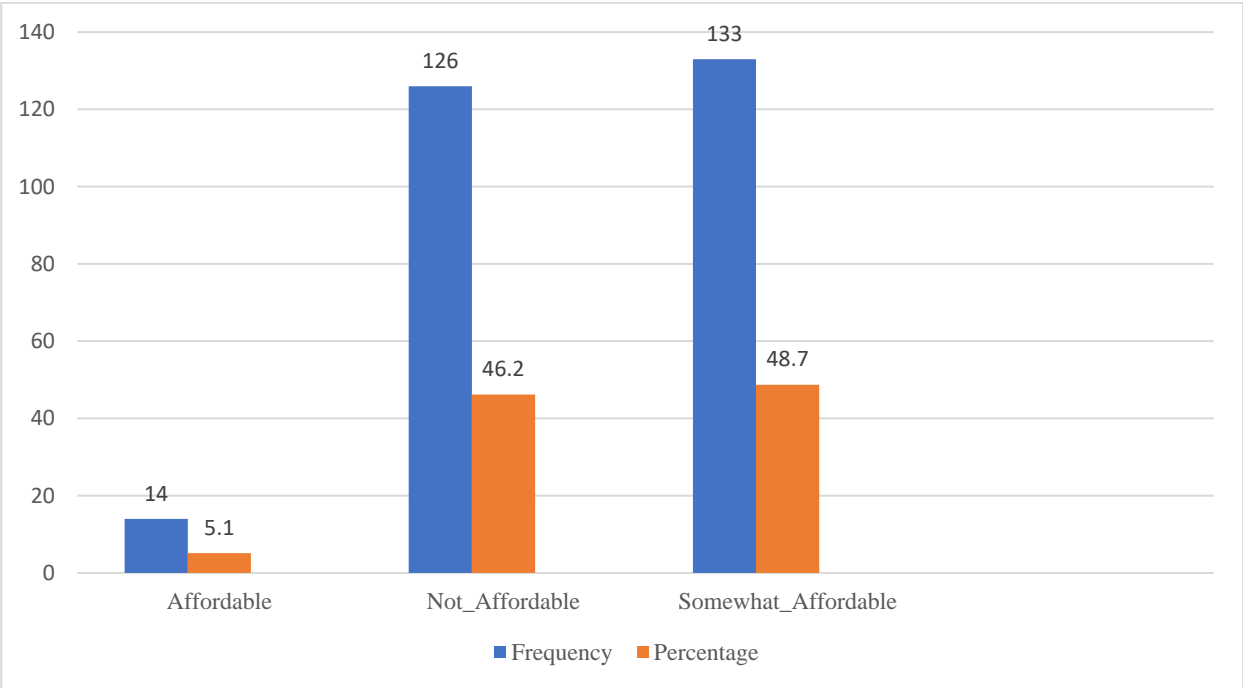
More than half (57.9%) of respondents cited not having access to CSA information (Figure 4.8). Also, (46.2%) of respondents reported that the cost of communication tools was unaffordable, while only 5.1% stated they could afford the cost of purchasing CSA communication tools (Figure 4.9). Furthermore, a majority of respondents (68.1% and 31.1%, respectively) highlighted that gender roles and farmers' educational levels significantly impacted their access to CSA information (Table 4.5). To analyze the influence of socioeconomic factors on smallholder farmers' access to CSA communication and education, a chi-square test was conducted. The results revealed that several sociodemographic variables have a significant association with the respondents' access to CSA information. These include the farmers' primary occupation ( $P = 0.009^*$ ), monthly household income ( $P = 0.003^*$ ), the presence of other income-contributing household members ( $P = 0.003^*$ ), and the amount spent on airtime ( $P = 0.011^*$ ) (Table 4.6).

### **4.3.2 MLR Results showing the relationship between socioeconomic factors and access to CSA information by smallholder farmers in the CRR**

Several variables show statistically significant relationships with access to CSA information. For instance, Access to extension workers has a highly significant positive coefficient (0.34,  $p < 0.001$ ), indicating that individuals with access to extension workers are considerably more likely to have CSA information. Marital status, however, reveals significant effects, with separated individuals' coefficient (1.077,  $p = 0.037$ ) and widowed respondents' coefficient (1.245,  $p = 0.005$ ) having higher access to CSA information compared to the baseline category (Table 4.7)



**Figure: 4.8** Farmers’ Access to Climate-Smart Agriculture Information in CRR



**Figure 4.9** Affordability of different CSA communication tools by smallholder farmers in the CRR

**Table 4.5: Social factors that impact smallholder farmers' access to CSA education and information**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage</b>
<b>How gender roles affect farmers' access to CSA education and information</b>		
No	87	31.9
Yes	186	68.1
<b>Farmers' social status and how it affects access to CSA communication and education</b>		
No	251	91.9
Yes	22	8.1
<b>Farmers' educational level and its impacts to their level of understanding of CSA messages</b>		
High Impact	83	30.4
Low Impact	85	31.1
Moderate Impact	92	33.7
No Impact	13	4.8
<b>Is language a barrier to understanding CSA messages</b>		
No	156	57.1
Yes	117	42.9

**Table 4.6: Chi-square test results showing the association between sociodemographic factors and farmers' access to CSA information in the CRR**

<b>Variables</b>	<b>No</b>	<b>Yes</b>		
<b>Major occupation</b>			13.439	0.009**
Artisan	6	0		
Civil Servant	4	11		
Farmer/Fisherman	144	99		
Private employment	3	4		
Student	1	1		
<b>Monthly household income from major occupation</b>			17.995	0.003***
<5000	96	50		
>50000	5	13		
10000_20000	38	33		
21000_30000	11	14		
31000_40000	4	5		
41000_50000	4	0		
<b>Do you have an income-contributing person</b>			9.058	0.003***
	118	40		
	66	49		
<b>Ethnicity</b>			13.994	0.007**
Fula	14	6		

Jola	3	0
Mandinka	52	59
Wolof	80	48
Others	9	2
<b>Household monthly spending on airtime</b>		16.521 0.011*
>3100	9	12
100_500	67	53
600_1000	54	22
1100_1500	6	12
1600_2000	15	6
2100_2500	2	5
2600_3000	5	5

**Table 4.7: MLR results showing the relationship between socioeconomic factors and smallholder farmers' access to CSA information**

CSA	Coef.	St. Err.	t-value	p-value	[95% Conf Interval]	Sig
<b>Gender: base</b>	0	.	.	.	.	.
Female						
Male	-.033	.064	-0.51	.612	-.159	.094
<b>Marital Status: b~e</b>	0	.	.	.	.	.
Divorce	.148	.264	0.56	.576	-.373	.668
Married	.11	.136	0.81	.421	-.158	.378
Separated	1.077	.513	2.10	0.037	.067	2.086 **

Single	.307	.358	0.86	.393	-.399	1.012	
Widowed	1.245	.434	2.87	0.005	.389	2.1	***
<b>EDU.LEVEL:</b> base i~a	0	.	.	.	.	.	
No_Forma Education	.141	.069	2.05	0.042	.005	.276	**
Primary	-.009	.102	-0.08	.933	-.209	.192	
Secondary	.004	.104	0.04	.971	-.2	.208	
Tertiary	-.238	.167	-1.43	.155	-.567	.091	
<b>AGE</b>	.029	.027	1.09	.276	-.023	.082	
<b>Major Occupation:</b> ~n	0	.	.	.	.	.	
Civil Serva nt	.885	.238	3.72	0.000	.416	1.354	***
Farmer/Fish erman	.315	.201	1.57	.119	-.081	.711	
Professiona lly_Emp~ P	.525	.275	1.91	0.057	-.017	1.067	*
Student	.019	.438	0.04	.965	-.843	.882	
<b>Land Ownership</b> b~l	0	.	.	.	.	.	
Leased	.193	.204	0.95	.344	-.208	.594	
Owned	.178	.201	0.89	.375	-.217	.574	
<b>Hhi</b>	-.027	.016	-1.66	0.097	-.058	.005	*
<b>Airtime</b>	-.017	.012	-1.37	.172	-.041	.007	
<b>AFFORDABILITY</b> ba~e	0	.	.	.	.	.	
Not Afford able	.212	.139	1.52	.129	-.062	.485	
Somewhat Affordab le	.191	.135	1.41	.159	-.075	.457	
<b>Social Status:</b> ba~o	0	.	.	.	.	.	

Yes		-.073	.105	-0.70	.486	-.28	.133	
<b>Access to Ex.Worker~o</b>	<b>to</b>	0	.	.	.	.	.	
Yes		.34	.061	5.56	0.000	.219	.46	***
Constant		.468	.356	1.31	.19	-.234	1.17	
Mean dependent var		1.422		SD dependent var		0.495		
R-squared		0.225		Number of obs		270		
F-test		2.706		Prob > F		0.000		
Akaike crit. (AIC)		370.657		Bayesian crit. (BIC)		467.814		

\*\*\* p<.01, \*\* p<.05, \* p<.1

#### 4.4 Impact of CSA communication and education initiatives on farmers' resilience to climate shocks and extremes

On assessing how CSA communication and education initiatives have improved farmers' resilience during climate shocks, the majority of the respondents (40.3%) reported little improvement, and (16.5%) responded to have significant improvement. On the importance of timely climate information on farmers' decisions, (40.7%) of the respondents have reported that timely climate information can be helpful to them. Also, (31.9%) of the respondents reported that CSA education and communication have a low impact on their farm diversification techniques (Table 4.8).

**Table 4.8: CSA communication and education and how it improves the resilience of smallholder farmers in the CRR**

Variables	Frequency	Percentage
<b>The Extent to Which Farmers' Resilience Has Improve Since Receiving CSA Information</b>		
Little Improvement	110	40.3

Moderate Improvement	112	41.0
No Improvement	6	2.2
Significant Improvement	45	16.5

**How CSA Education Improved Farm Productivity During Climate Extremes**

No	178	65.2
Yes	95	34.8

**The Frequency at Which Farmers Implement CSA Practices**

Daily	8	2.9
Monthly	64	23.4
Weekly	46	16.8
Yearly	155	56.8

**Impact of Timely Climate Information on Farmers' Farming Decision**

Helpful	111	40.7
Neutral	80	29.3
Unhelpful	4	1.5
Very_Helpful	78	28.6

**Do you feel better prepared for future climate risks due to CSA trainings**

No	185	67.8
Yes	88	32.2

**CSA Communication and its Impacts on Diversification of Farmers' Farming Techniques**

High_Impact	42	15.4
Low Impact	87	31.9
Moderate Impact	135	49.5
No Impact	9	3.3

#### 4.5.1 How CSA communication and education initiatives differently impact men’s and women’s adoption of CSA practices in CRR

A good number of the respondents (51.3%) indicated that decisions regarding CSA adoption are predominantly made by husbands alone. Additionally, (56.8%) of the respondents reported that men and women have equal participation in CSA education and training. However, a significant portion (71.4%) of the respondents believed that gender-based barriers limit smallholder farmers' access to CSA communication and education (Table 4.9).

#### 4.5.2 Multiple Linear Regression on CSA Adoption by Gender in CRR

In terms of CSA adoption decisions, variables like men more often, have a significant negative coefficient (-0.48,  $p < 0.01$ ), suggesting that in households where men make decisions more frequently, CSA adoption is less likely. Conversely, CSA training based on gender shows a significant negative coefficient (-0.256,  $p < 0.01$ ), implying that participation in CSA training on gender-based is associated with decreased CSA adoption (Table 4.10).

**Table 4.9: Gender-Based Barriers and Their Impact on Farmers' Access to CSA Communication and Education**

Variables	Frequency	Percentage
<b>Who makes decisions concerning CSA Adoption in your household</b>		
Husband Alone	140	51.3
Jointly	95	34.8
Wife Alone	38	13.9

**What is the level of CSA program participation by women vs men**

Equal Participation	155	56.8
Men More Often	20	7.3
Women More Often	95	34.8

**Do Gender-Based Barriers Limit your access to CSA training**

No	78	28.6
Yes	195	71.4

**Do men and women have equal CSA Support from Extension Officers**

No	157	57.5
Yes	116	42.5

**Do you think men have more Access to CSA Communication Tools than women**

No	97	35.5
Yes	176	64.5

**Are CSA Trainings Tailored to Gender-Specific Needs**

No	112	41.0
Yes	161	59.0

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**Table 4.10: Multiple Linear Regression results showing how different gender factors influence CSA adoption in the CRR**

CSA_A	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
<b>Gender-Based Barri~o</b>	0	.	.	.	.	.	
Yes	.16	.093	1.71	0.088	-.024	.344	*
<b>CSA P.P by men vs ~p</b>	0	.	.	.	.	.	
Men More Often	-.48	.168	-2.85	0.005	-.812	-.148	***
Women More Often	.147	.091	1.61	.108	-.033	.327	
<b>Sup.from Ex. Worker~o</b>	0	.	.	.	.	.	
Yes	-.002	.088	-0.02	.986	-.174	.171	
<b>Acc to CSA Comm to~o</b>	0	.	.	.	.	.	
Yes	-.017	.092	-0.18	.854	-.198	.164	
<b>CSA training on Ge~b</b>	0	.	.	.	.	.	
Yes	-.256	.088	-2.92	0.004	-.429	-.084	***
Constant	1.668	.121	13.74	0.000	1.429	1.907	***
Mean dependent var		1.633	SD dependent var			0.718	
R-squared		0.089	Number of obs			270	
F-test		4.308	Prob > F			0.000	
Akaike crit. (AIC)		575.064	Bayesian crit. (BIC)			600.253	

\*\*\* p<.01, \*\* p<.05, \* p<.1

## 4.6 Discussions

### 4.6.1 Farmers' Perception of CSA in the Central River Region

This study reveals that most smallholder farmers in the CRR of The Gambia perceived composting as a Climate-Smart Agriculture (CSA) practice. While many respondents across the studied communities indicated a basic awareness of composting, this knowledge is largely attributed to the efforts of non-governmental organizations (NGOs) and some government projects operating in the region. However, most farmers reported that their limited understanding of composting did not come from extension workers or formal CSA communication channels but through farmer associations (social capital) whose leaders mostly take part in the training of trainers organized by NGOs. These findings differ from those of Meshesha et al., (2022) in their studies in the upper Blue Nile Highlands of Ethiopia, who found that most smallholder farmers have demonstrated a good perception of CSA innovation within various agroecosystems, leading to increased soil fertility, income level, soil organic matter (O.M), and reduced soil erosion.

During a focus group discussion (FGD) in one of the studied communities, a respondent who is also a lead farmer highlighted how low perception and awareness of CSA practices impact farming activities. He stated *"We have experienced significant changes in rainfall trends over the years. Coupled with farmers' limited understanding of best CSA practices, these changes have negatively impacted our harvests. Crops we used to grow cannot thrive anymore due to frequent droughts, locally called 'Jaa' in Mandinka, or heavy downpours that cause flooding, especially in rice fields."* (Source: FGD 1)

However, some farmers attributed poor harvests not to farmers' limited perception of CSA but to divine will, expressing their belief that God ('Allah') controls rainfall and harvest outcomes. These findings corroborate that of Kargbo et al.,(2023) in their studies on farmers' perception and impact of climate variability on livestock farming in the Gambia, which found that most farmers attached changes in rainfall and temperature patterns and agricultural output as God's punishment due to human disobedience to religious teachings.

Regarding the role of local leaders in promoting sustainable farming, the village head ('Alkalo') in one of the studied communities shared that during village meetings, farmers are encouraged to diversify their production. This includes the incorporation of small ruminant production such as sheep and goats while adopting more CSA practices such as agroforestry, water management,

and mulching. Further noting that CSAPs such as agroforestry can be very beneficial since the fruit trees could provide additional income and resources for farmers during crop failures (KII, 'Alkalo').

#### **4.6.2 Effectiveness of the different communication channels in disseminating CSA**

While studies on the effectiveness of CSA communication channels remain very limited in The Gambia, the findings from this study indicate that CSA information dissemination in the CRR is generally poor. Farmers expressed concerns about limited access to CSA information through various channels, including radios, televisions, extension workers, and social media platforms like WhatsApp. Despite these challenges, radios were identified as relatively more effective and accessible than other communication channels. These findings are consistent with studies by Eta et al., (2023) on Crop Farmers' Access to E-information for climate-smart agriculture production in Cross River State, Nigeria, which found that the majority of the farmers got CSA information through radios.

However, these are in contrast with findings from Waaswa et al., (2021) and Mbukwa, (2015), which highlighted extension services as the most effective means of CSA communication among smallholder potato farmers in Gilgil sub-county of Kenya and Bolero, Rumphi District in Malawi respectively. In line with the findings of this study, Waaswa et al., (2021) further noted that well-targeted CSA communication can significantly promote sustainable agriculture, empower vulnerable farmers (such as women), and contribute to achieving Sustainable Development Goals (SDGs). Smallholder farmers in the studied areas have also identified several impediments to accessing CSA information, including insufficient extension workers and poor network coverage in rural areas.

Furthermore, a participant during the Key Informant Interview revealed additional structural barriers. These include a significant knowledge gap, the absence of a robust institutional framework, and the limited capacity of extension staff. The participants noted that poorly structured educational curricula at institutions such as Gambia College and the University of The Gambia and the government's reluctance to deploy sufficient extension workers have exacerbated the issue. As a result, the extension worker-to-farmer ratio stands at 1:3,500, far above the recommended standard (Source: KII 2). These findings corroborate studies by Msuya et al., (2017) who explored the role of agricultural extension in Africa's development and discovered that more than half of extension workers across different African countries do not have the required knowledge or competence in using ICT for extension services.

Regarding farmers' preferred communication channels, many expressed a preference for television over other media due to its audio-visual nature. Farmers believe that the ability to both see and hear CSA practices being demonstrated would significantly improve their understanding and adoption of sustainable farming methods. Furthermore, the findings are similar to those by Levitan, (2016), who revealed that most smallholder farmers in the Kilosa District of Tanzania expressed their preference for TVs over other channels of information, citing the same reasons.

Additionally, farmer associations and cooperatives, such as 'Senela Kafoo' in Sololo, 'Women Kaffoo' in Mamud Fana, and 'Wassu Kankilling kafoo' in Wassu, play a crucial role in disseminating CSA information. These groups provide training, particularly on compost making, through lead farmers. Beyond serving as CSA information sources, these associations also support their members with funds and agricultural inputs through local savings schemes ('susu'). Such initiatives have helped participating farmers improve production levels. These findings are consistent with those by Bashir et al., (2020), who found that the National Farmers Helpline of Nigeria supplies almost all the necessary agricultural information needed by farmers to boost their production.

#### **4.6.3 Association between socio-demographic variables and smallholder farmers' Perceptions of CSA practices in the CRR**

The chi-square test demonstrates different levels of connection between the socio-demographic factors and smallholder farmers' perception of CSAPs. The results show gender creates a statistically significant change in responses when analyzed ( $p = 0.038^*$ ). Gender appears to impact how people perceive and decide about climate-smart agriculture (CSA).

The association between response variation and household size proves statistically significant ( $p < 0.001^{***}$ ), which indicates that household population influences measured outcomes. Households exceeding 20 members displayed the greatest discrepancy. The diverse conditions that bigger households experience due to their larger size make their responses different.

Land ownership fails to produce a substantial connection with the response variable according to the calculated p-value ( $p = 0.593$ ). Survey respondents demonstrated no link between their land ownership type, whether owned, leased, or communal land, and how they answered the questionnaire. The result shows that major occupation and farmers' income in the past year fails

to demonstrate statistical significance ( $p = 0.366$ ), which indicates financial standing has minimal impact on participant responses. Economic indicators such as income together with land ownership status do not affect responses among people in this specific situation based on statistical testing ( $p = 0.593$  and  $p = 0.366$ ).

#### **4.7.1 Socioeconomic factors hindering farmers' access to CSA communication and education**

Farmers in the study area have identified several socioeconomic factors that hinder their ability to access timely and effective CSA communication and education to improve agricultural production. The findings from this study indicated that factors such as farmers' level of education, age, gender, land ownership, and household income significantly influence their access to CSA information and training. Consistent with the findings by Samoura et al, (2023) which revealed that farmers' age, gender, educational level, and livelihood diversification are among some important factors that influence farmers' access to CSA information and education in the Guinean Savanna Agroecological Zones.

A significant portion of farmers in the study expressed that the high cost of living has constrained their ability to afford communication tools and educational resources for CSA. Many reported that their limited income is prioritized for basic household needs, including food, water, electricity, and clothing. This financial strain leaves little room for expenses on televisions, radios, or other CSA-related resources. In an FGD held in one of the studied communities, a farmer shared:

*"We experience numerous difficulties in accessing CSA information because most of our money is spent on basic needs. This makes it difficult to buy televisions or radios. Most of us rely on mobile phones to listen to the radio, but this is also challenging due to poor network coverage and unreliable electricity supply for charging our phones"* (Source FDG 2).

Additionally, married women in the study area cited unique challenges in accessing CSA information and training. Matrimonial responsibilities occupy much of their time, making it difficult for them to engage in educational programs or attend training sessions. Cultural and institutional barriers further exacerbate these challenges. Many women reported being excluded from decision-making processes and faced issues such as the high cost of agricultural inputs, lack of access to credit facilities, and limited ownership of productive resources like land. These barriers significantly hinder their ability to adopt CSA practices and cope with climate

variability. These findings align with studies by Ngigi & Muange, (2022) and Mogaka et al., (2021), which also highlight the disproportionate burden placed on women farmers in accessing climate-smart agriculture information in Kenya.

Educational levels among farmers were also found to play a critical role in CSA communication. With most respondents reporting not having any form of formal education, most farmers rely on informal education systems, such as the 'Informal Madrassa.' Many farmers stated that their limited educational background makes it challenging to understand CSA messages. However, some respondents acknowledged that translating information into local languages has helped them grasp the basic concepts of CSA practices despite their limited formal education. These findings corroborate Mogaka et al., (2021), who found that farmers' level of education played a critical role in their understanding of best CSA practices in Western Kenya.

Assessing how farmers' social status in the community can also have an impact on their access to CSA communication and education, the majority of respondents answered that social status was not an issue and does not in any way affect their access to CSA communication and education services within their communities. However, these findings differ from Diouf et al (2019) who found that farmers' social status within their communities was an important factor in their access to CSA information for their agricultural production in Senegal, a close neighbouring country to The Gambia. For example, they noted that women who are natives of their area of residence have better access to information than those who are not. Likewise, women who belong to the 'Diola' tribe have better access to CIS, this is because the Diola tribe is mainly the native of the area.

#### **4.7.2 Associations between Sociodemographic Variables and Farmers' Access to CSA Information in the CRR**

Our chi-square test results suggested a significant association between various socio-demographic factors and smallholder farmers' access to CSA information in the studied areas. Farmers' major occupation for instance shows a significant association with their access to CSA information ( $P=0.009^*$ ). Farmers were the largest group while people appointed in the private sector were the lowest. Similarly, farmers' monthly household income from major occupations also revealed a significant association with their access to CSA information ( $P=0.003$ ). This trend suggests that farmers with high-income levels may have more access to CSA information.

This finding is in line with (Ogada et al., 2020), who noted that smallholder farmers' income level has a significant influence on their access and adoption of CSAPs in Nyando basin of Kenya.

Furthermore, the availability of income-contributing persons in the household shows a significant association ( $P=0.003$ ). Suggesting that households with more than one income-contributing person tend to have better access. Farmers' ethnicity is also another key influencing factor in their access to CSA information ( $P=0.007$ ). Mandinka and Wolof populations tend to have more access than other tribes since they form the majority in the studied region.

Finally, monthly airtime spending also shows a significant association with CSA information access in the CRR ( $P=0.011$ ). This may suggest that individuals who have the financial capacity to buy more airtime may have more information compared to those with lower spending. Furthermore, this indicates that access to mobile credit may further enhance individuals' access to CSA information. This finding aligns with (Mwikamba, 2022) who revealed that the majority of smallholder farmers who have access to airtime adopted most CSAPs compared to those who do not have access to mobile air time in taitaveta county, of Kenya.

#### **4.7.3 Relationship between Socioeconomic Factors and Smallholder Farmers' Access to CSA Information the CRR**

The result of the multiple regression analysis revealed key factors influencing smallholder farmers' access to CSA information. The dependent variable, "Do you have access to CSA information?" is binary (yes/no). Coefficients, standard errors, t-values, p-values, and confidence intervals for various predictor variables were shown to provide a comprehensive assessment of their impact on CSA information accessibility. Several variables show statistically significant relationships with CSA information access by smallholder farmers in the study area. For instance, access to Extension workers, marital status, especially Separated and Widowed compared to the base category, show statistically significant associations with CSA information access of smallholder farmers. This indicates that individuals with access to extension workers are considerably more likely to have CSA information. Moreover, certain marital groups, perhaps as a result of changes in household responsibilities or social support structures, have greater engagement with CSA information sources.

Education level is another key factor, particularly for those without formal education, who exhibit a positive and statistically significant coefficient. These findings suggest that

individuals with no formal education tend to seek knowledge through alternative means to learn about CSA. However, education levels, such as primary, secondary, and tertiary education, do not show significant effects, indicating that formal education alone may not be a strong determinant of CSA knowledge acquisition. The socioeconomic status of civil servants creates favourable conditions for them to obtain CSA-related information, which offers them increased access to such content. The relationship between professionally employed workers in the private sector and CSA information access demonstrates a weak positive effect, yet farmers and fishing employees display no pronounced connections despite their fundamental role in CSA programs.

However, several other variables do not show statistically significant relationships with access to CSA information. For example, gender, age, and land ownership do not show statistically significant p-values, suggesting that these factors may not play a substantial role in determining access to CSA information, at least within this model. It's important to note that statistical significance doesn't necessarily imply practical significance. While some coefficients might be statistically different from zero, their effect sizes might be small.

Furthermore, the R-squared value of 0.225 indicates that the model explains 22.5% of the variance in access to CSA information, suggesting that other unmeasured factors might also be at play. Additionally, the table includes various model diagnostics such as the F-test, AIC, and BIC, which are useful for assessing the overall fit and comparing with different models.

#### **4.8 CSA Communication and education initiatives and its impacts on farmers' resilience to climate shocks and extremes**

The assessment of how CSA communication and education initiatives contribute to building farmers' resilience during climate shocks, such as floods and droughts, revealed several key findings. A majority of farmers in the studied areas reported that limited awareness and understanding of CSA practices, primarily due to inadequate information dissemination, resulted in only marginal improvements in their agricultural productivity. A similar study by Maritim et al., (2022) in the agro-pastoralist community of West Pokot County, Kenya, also points out that with insufficient and poor dissemination of information on CSA technologies, farmers are unable to adapt to cultivate better crop cultivars and better animal breeds that can adapt to the changing climate.

When asked about the impact of CSA communication and education on their resilience during climate extremes, a farmer from one of the studied communities, during our FGD, said: *“We have not experienced any significant improvement in our resilience. In past decades, we used to have bumper rice harvests, but now all our rice fields are affected by salt intrusion. Our groundnut farms have also suffered from severe drought, resulting in very poor yields”* (Source: FGD, 3).

Regarding the importance of timely Climate Information Services (CIS) for farming decisions, most farmers responded positively, emphasizing that access to timely CIS could significantly enhance their resilience. They noted that such information would enable them to make informed decisions regarding farming activities, thereby improving their adaptive capacities and preparedness for climate change impacts. However, these findings align with Teklu et al., (2023a), who noted that access to basic CIS has enhanced smallholder farmers' resilience and enabled the embrace of transformative CSA practice in the Blue Nile Highlands of Ethiopia.

Additionally, farmers expressed limited knowledge about farm diversification, a key CSA technique that can enhance resilience, particularly during climate shocks. Contrary to the findings by Mkwambisi et al., (2021) who revealed in their study that the majority of farmers in Malawi felt prepared for future climate-related extremes owing to effective CIS provided for farmers at the beginning of every growing season. However, farmers in the studied areas were asked about their level of preparedness for future climate-related extremes, and more than half of the respondents indicated that they felt unprepared, primarily due to the lack of effective CSA information dissemination targeted at the appropriate audiences to strengthen resilience.

Furthermore, when questioned about access to social safety nets (SSN) and promotion of CSA, an important aspect of bolstering farmers' resilience during situations of extreme weather events, the majority of the farmers responded that they do not receive sufficient SSN from the government during extreme weather conditions. These findings differ from those by Gondwe et al., (2023), who, in their study on SSN programs and household resilience in Malawi, revealed that SSN initiatives such as non-employment activities, participation in cash transfer programs, access to own savings, and improvements in education, mainly through the National Social Support Policy and National Resilience Strategy, are helping farmers build their resilience and helping them to cope during extreme climate events.

#### **4.9.1 The different impacts of CSA communication and education initiatives on men and women's adoption of CSA practices in CRR**

The results of this study indicate that decisions regarding the adoption of Climate-Smart Agricultural Practices (CSAPs) within households are predominantly made by husbands, with women often excluded from the decision-making process. The study further revealed that cultural and religious norms significantly influence this dynamic, reinforcing the perception that women should not have the right or privilege to make decisions in the presence of their husbands. These findings align with those of Boudalia et al., (2024) and Waroga, (2019), who found that married male smallholder farmers utilized more CSA practices in their farms than female farmers. They further noted that the gender gap in CSA adoption is predominantly caused by discrimination related to social norms, culture, and other factors that discriminate against women and prevent them from taking part in economic activities in Africa.

However, the findings indicate that inclusive approaches are used in some few households, where both men and women participate in decisions regarding CSAP adoption. Given the critical role women play in the agricultural sector in most African countries, including The Gambia, male dominance in decision-making could negatively impact CSA adoption and hinder the broader achievement of sustainable agriculture in line with the United Nations Sustainable Development Goals (UNSDGs).

Despite the prevalence of male dominance in decision-making in CSA adoption in the study area, most respondents acknowledge equal participation of men and women in CSA education and training programs. The primary reason cited for this inclusivity is that both genders are actively engaged in agricultural practices. However, some respondents stated that women participate more than men in these programs. The reason for this is due to the efforts of some Non-Governmental Organizations (NGOs) and women's involvement in agricultural activities year-round. In line with Waaswa et al., (2021) who revealed that smallholder potato farmers in Gilgil Sub-County of Kenya were more likely to adopt CSAPs than male counterparts due to their active participation in farming activities.

The study also identifies significant gender-based barriers limiting smallholder farmers' access to CSA communication and education. These barriers include cultural norms, religious restrictions, time constraints, and financial limitations, which disproportionately hinder women's participation in CSA training. During our FGD, when asked about the impacts of GBB in accessing CSA information, one female farmer stated: *“Yes, it does, because I am married,*

*and my husband mostly does not allow me to attend such trainings.*” Another woman added: *“Women are asked to stay home because most trainings are conducted outside of the community”* (Source: FGD, 3). These findings are consistent with those by Ogisi and Begho, (2023) who reported the existence of GBB in the access to CSA information by smallholder farmers in Kenya. They noted that male farmers have more access to extension workers as compared to female farmers, which has limited their understanding and adoption of CSAPs.

Regarding support from extension workers, the results of the study highlight an imbalance in CSA support for men and women. Similarly, the findings indicate that men have greater access to CSA communication tools such as televisions, radios, and mobile phones. Many women attributed this disparity to men having higher incomes, which grants them better access to these resources. These findings align with several other studies, such as those of Huyer (2021) and Ogisi & Begho (2023), which revealed similar findings in their studies, noting several obstacles facing women in accessing CSA in Sub-Saharan Africa SSA.

#### **4.9.2 Relationship between some Gender Factors and Smallholder Farmers' Access to CSA Information in the CRR**

The findings of the multiple regression analysis suggested that numerous gender-related factors hinder the successful adoption of CSAPs in the CRR. For instance, men participate more in CSA programs than women and male-made household decisions reduce the likelihood of CSA adoption. However, there is little but significant positive correlation between gender-based barriers (GBB) adoption. Suggesting that while gender-related constraints may limit access to resources, they do not completely stop adoption.

This suggests that despite facing systemic barriers, some women still engage in CSA practices, potentially due to resilience-building efforts or alternative knowledge-sharing mechanisms within their communities.

Moreover, CSA training that incorporates gender-based approaches has a significant negative effect, suggesting that the way gender-focused training is currently conducted may not be effectively translating into higher adoption rates. This could indicate a need for improved training methodologies that better align with the unique challenges faced by men and women in CSA adoption.

However, several other variables do not demonstrate statistically significant relationships with CSA adoption decisions. For instance, access to extension workers and access to CSA communication tools do not have statistically significant p-values, indicating that these factors may not play a substantial role in household CSA adoption decisions, according to this model. This implies that merely providing access to CSA information is not sufficient to drive adoption unless it is accompanied by targeted and practical interventions.

## **CHAPTER 5**

### **SUMMARY, CONCLUSION AND RECOMMENDATION**

#### **5.1 Research Summary**

This study investigates the integration of Climate-Smart Agriculture (CSA) communication and education in The Gambia's Central River Region (CRR) to enhance resilience and sustainable farming practices. The study used primary data to collect data from the respondents and employed descriptive and inferential statistics for the data analysis. Research findings show that smallholder farmers demonstrate a low understanding and practice of CSA techniques because many farmers know about composting as the only CSA method. Knowledge dissemination activities in this region depend heavily on non-governmental organizations (NGOs) and farmer groups as well as formal extension programs that fail to maximize their potential. The farmers' capabilities to obtain and put CSA information into practice are negatively affected by gender imbalances and differential social status, along with their access to communication means.

A combination of survey data, focus group discussion, and key informant interview methods was used to analyze how well CSA information distribution systems function in this study. Results suggest that radio and television serve as primary information sources yet corresponding costs and poor network coverage limit their effectiveness as channels in effective CSA information dissemination. Gender-based barriers have also prevented women from participating in CSA programs since cultural norms, alongside domestic responsibilities, prevent them from attending training sessions. The knowledge gap becomes worse due to reduced interaction between farmers and extension workers since farmers mostly depend on informal networks for information sharing.

Statistical data demonstrate that farmers who belong to different economic strata show varying abilities to access sustainable agricultural knowledge. Regression analysis and chi-square tests provide evidence of this relationship. The research demonstrates that several government initiatives exist, but the spread of CSA practices remains nomadic. A slow adoption rate of CSA technologies occurs due to insufficient communication strategies that accommodate varying levels of literacy and cultural backgrounds. The study establishes that farmers need specific interventions that will both minimize communication barriers and strengthen their resistance to climate change impacts.

## 5.2 Conclusion

The findings of this study demonstrate that the current CSA communication and education strategies in the CRR are inadequate in reaching smallholder farmers effectively. Many farmers have not adopted CSA best practices because of insufficient communication systems and limited extension services availability. The traditional gender-based cultural norms stop women from joining CSA adoption training sessions and exclude them from making key decisions about agricultural practices.

This study finds that CSA communication stands crucial for sustainable agriculture but current distribution systems fail to adapt to socio-economic as well as cultural constraints. Farmers depend on both NGOs and informal farmer networks as sources of CSA knowledge because they lack sufficient support from government agricultural institutions. The analysis shows that communication approaches must be expanded to include methods that capture all groups, especially women and illiterate farmers who need special attention.

Successful implementation of CSA communication requires a comprehensive working strategy that provides opportunities for all farmers to learn and benefit from such practices. Socio-economic inequalities across gender-based disparities must be resolved. This will ensure the effective spread of CSA practices throughout the region. National policies require revisions to develop CSA educational programs that serve different farming demographics in accessible locations throughout the region.

## 5.3 Recommendation

In the quest to achieve the United Nations (UN) Agenda 2030 and the African Union (AU) Agenda 2063, 'The Africa We Want,' this study proposes the following measures to empower smallholder farmers through the effective integration of Climate-Smart Agriculture (CSA) communication and education for sustainable farming in The Gambia's Central River Region (CRR):

- A) **Employ More Extension Workers to Meet the Required Needs of Farmers:** The majority of the farmers have expressed a lack of access to CSA information through extension staff. This has reduced their overall knowledge and understanding of CSAPs, causing a poor adoption rate. Thus, the ministry of agriculture should collaborate with the private sectors and other government agencies to train and deploy more extension workers

to meet farmers' needs. Extension service can also be strengthened through the creation of a community-led extension model where trained lead farmers can serve as intermediaries.

- B) **Improve Farmer Access to CSA Information:** Most smallholder farmers have preferred TVs over other information dissemination methods. Therefore, the Ministry of Agriculture should develop a localized CSA communication strategy in collaboration with the Ministry of Information and Communication. This will involve the establishment of TV stations that will disseminate different CSA-based contents. This strategy should also include the translation of CSA information into local languages using storytelling techniques and integrating pictorial messages to ensure understanding among low-educated farmers. These knowledge-sharing structures will help to create a mutual learning environment through knowledge exchange. Strengthening community radio stations and social media platforms like WhatsApp can help improve CSA information dissemination, especially in remote areas with limited TV access.
- C) **Strengthening of Farmer Cooperative Societies or Associations:** Evidence from this study has shown that some smallholder farmers access training through farmers' associations or cooperative societies. Therefore, the ministry of agriculture in collaboration with NGOs, should help enhance the formation of farmer cooperative societies. This will help enhance peer-to-peer learning sessions where experienced farmers share best CSA practices with other members while offering financial aid, leadership training, and networking opportunities for their members.
- D) **Develop Gender-Sensitive CSA Policies:** Gender differences in access to CSA communication and education remain a major obstacle to sustainable farming in the CRR. To address this, the Ministry of Agriculture in partnership with the Gender ministry and the NGOs should ensure an equal access to CSA training, extension services, and financial support for women farmers. This will help them have access to CSA information dissemination tools such as TVs, radios, and mobile phones. Additionally, women's participation in decision-making regarding CSA adoption must be encouraged by empowering women through policies and strategies. Gender-sensitive extension services should be introduced; this will take into consideration the cultural and societal norms that often limit women's involvement and access to CSA information in the CRR.
- E) **Integration of CSA Communication and Education into National Policies:** Climate-Smart Agriculture Communication and Education should be fully incorporated into relevant national agricultural policies, such as the Agriculture and Natural Resources (ANR) Policy, for long-term sustainability. This can be achieved through collaboration

between the government, NGOs, and private institutions, which will help provide a conducive environment for the effective implementation of CSAPs.

**F) Enhance Farmer Access to Climate Information Services:** Most smallholder farmers cited the importance of timely CIS in helping to improve their farming decisions. The Ministry of Agriculture should collaborate with the Department of Water Resources to help provide a localized weather forecast system tailored to specific farming zones. This will also involve the establishment of an accurate CIS with Early Warning Systems that can help boost the adaptive capacity of smallholder farmers.

#### **5.4 Suggestions for Further Research**

While there exists a limited number of studies about climate-smart agriculture communication and education in The Gambia, future research should focus on evaluating the effectiveness of various CSA communication channels in different socio-economic and cultural contexts. The authors demonstrate radio and television serve as primary information sources for CSA but future studies need to examine mobile technology alongside community-based sharing platforms and social media platforms for understanding CSA practices adoption. Unveiling the behavioural and psychological elements of farm households when adopting CSA practices would unlock comprehensive knowledge about how they handle and benefit from CSA information.

Another critical area for further research is the gender dynamics of CSA adoption, particularly in regions with strong cultural and societal norms limiting women's participation. Research needs to evaluate what methods will work best to provide women with increased access to Sustainable Agricultural information and authority structures in household farms. Future research must analyze ways to incorporate CSA communication approaches within national agricultural extension policies to support sustainability for long-term and large-scale implementation. Researchers need to evaluate both short- and long-term implications of CSA education for farmers to build resilience against climate-related events that include floods and droughts.

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**APPENDIX**

**APPENDIX I: Survey questionnaires**



**PAN-AFRICAN UNIVERSITY  
INSTITUTE FOR WATER AND ENERGY SCIENCES  
(Including CLIMATE CHANGE)**

**Master Dissertation Data Collection Questionnaires**

**Salifu Dumbuya**

**MSc Climate Change Policy**

**Empowering Resilience: Integrating Climate-Smart Agriculture  
Communication and Education for Sustainable Farming in The Gambia's  
Central River Region**

**Dear Valued Respondent,**

I am Salifu Dumbuya, a student pursuing a Master's in Climate Change at the Pan African University Institute for Water and Energy Sciences (Inc. Climate change). One of the requirements for my academic task is to conduct and submit a written research report; thus, I need this survey. The questionnaires consist of statements that are made to assess the integration of Climate-Smart agriculture communication and education for sustainable farming in The Gambia's Central River Region.

I would therefore be grateful if you could kindly and candidly answer the questions. Your answers will be very important for my research as they will contribute immensely towards how to best integrate CSA communication and education for sustainable agricultural production while improving the resilience of smallholder farmers against the shocks of climate change in CRR. Please be rest assured that your responses will be used only for this study and will be kept private and confidential.

For further clarification regarding this research, you can contact me via email at: [salifudumbuya5@gmail.com](mailto:salifudumbuya5@gmail.com) or +2203575853 you may also contact my main academic supervisor Professor Innocent Ifelunini, University of Nigeria, Nigeria Nsuka: [innocent.ifelunini@unn.edu.ng](mailto:innocent.ifelunini@unn.edu.ng) or my co-supervisor Dr Alpha Kargbo, University of The Gambia: [akargbo@utg.edu.gm](mailto:akargbo@utg.edu.gm)

**Empowering Resilience: Integrating Climate-Smart Agriculture Communication and Education for Sustainable Farming in The Gambia's Central River Region**

**1.0 Socio-demographic characteristics of respondents (please tick the appropriate answer)**

1.1 Gender	Male			Female					
1.2 Marital status	Never Married/ Single			Married		Widowed			
	Divorced			Separated		Consensual/loose union			
1.3 Educational level	No formal education	Informal (madrassa)		Primary		Secondary		Tertiary	
1.4 Age									
1.5 What is your major occupation?	Farmer/fisherman	Petty trader	Artisan	Businessman/woman	Civil servant	Professionally employed in the private sector	Professionally employed in the public sector	Student	Unemployed
1.6 What is your minor occupation?	Farmer/fisherman	Petty trader	Artisan	Businessman/woman	Civil servant	Professionally employed in the private sector	Professionally employed in the public sector	Student	Unemployed
1.7 Indicate your monthly household income from major occupation (over the last 12 months)									
1.8 Indicate your monthly household income from minor occupation (over the last 12 months)									
1.9 Do you have an income-contributing person in the household besides you?							Yes	No	
1.10 How many people contribute to this household income including you?									
1.11 For the first income contributing person, not you, please what is his or her monthly income?									
1.12 For the second income-contributing person, not you, please what is his or her monthly income?									
1.13 Religion	Islam			Christianity		traditional religion		Prefer not to say	
	Others (specify).....								
1.14 Land ownership	Owned			Leased		Communal land			
1.15 How many people live in your household?									
1.16 Ethnic group	Mandinka		Fula	Wolof		Jola		Other (specify).....	

1.17 Type of main crop grown	Rice	Groundnut	Maize	Millet	Other specify....
1.18 Years stayed in the community	1-3	4-6	7-9	10-12	>15
1.19 District					
1.20 How much did your household spend on food in the last one month?					
1.21 How much did your household spend on medical in the last one month?					
1.22 How much did your household spend on rent in the last one month?					
1.23 How much did your household spend on transportation in the last one month?					
1.24 How much did your household spend on airtime/data in the last one month?					
1.25 How much did your household spend on utility in the last one month?					
1.26 How much did your household spend on social activities in the last one month?					
<b>2.0 Effectiveness of different communication channels in disseminating CSA information to farmers in the Central River Region</b>					
2.1 Do you know about climate-smart agriculture?					
<input type="radio"/> Yes <input type="radio"/> No					
2.2 If your answer is yes, which of the following CSA types do you know?					
<input type="radio"/> Mulching <input type="radio"/> Cover cropping <input type="radio"/> Water management <input type="radio"/> Agroforestry <input type="radio"/> Composting					
Other specify.....					
2.3 Which of the following CSA types do you mostly use?					
<input type="radio"/> Mulching <input type="radio"/> Cover cropping <input type="radio"/> Water management <input type="radio"/> Agroforestry <input type="radio"/> Composting					

- Other specify.....

2.4 What is your main source of CSA Information?

- Radio
- Television
- Extension workers
- WhatsApp
- Internet
- Friends or Neighbours
- No communication means

Give reasons for your answer.....

Source of information	Frequency of Access of CSA information				
	Daily	Weekly	Monthly	Yearly	Never accessed
<b>Radios</b>					
<b>Television</b>					
<b>extension workers</b>					
<b>WhatsApp</b>					
<b>Internet</b>					
<b>friends/neighbours</b>					
<b>Others (specify)</b>					

2.5 How frequently do you access CSA information through the above-mentioned channels?

2.6 How frequently do you access CSA information through the above-mentioned channels?

Daily      Weekly      Monthly      Yearly      Never accessed

2.7 What challenges do you face in receiving CSA information via different communication platforms?

- Cost of communication tools
- Poor signal/network coverage
- Lack of CSA-specific content
- Other specify..... (as many as possible)

2.8 What is your preferred method of CSA information dissemination?

- Radio
- Social media
- Internet
- Television
- Social network (community, religious organization, farmers' organization, etc.)
- Extension worker (for officers)

2.9 Have you received CSA-related advice from **Extension Officers**?

Yes ( )      No ( )

2.10 If yes, what is the Level of CSA-related advice offered to you by Extension Officers?

- High
- Moderate
- Low
- None

<p>2.11 Do you belong to a farmer cooperative/any farmer association?</p> <p>Yes ( ) No ( )</p> <p>If yes, specify.....</p>
<p>2.12 Have you attended any seminars/training on CSA application?</p> <p>Yes ( ) No ( )</p>
<p><b>3.0 Socioeconomic factors that hinder farmers' access to CSA communication and education in the Central River Region</b></p>
<p>3.1 Do you have access to CSA information?</p> <p>Yes ( ) No ( )</p>
<p>3.2 If no, what are the challenges to accessing CSA information (list as many as possible)</p> <p>i.</p> <p>ii.</p> <p>iii.</p> <p>iv.</p> <p>v.</p> <p>vi.</p> <p>vii.</p>
<p>3.3 Does household income impact your access to CSA training programs or educational resources?</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p>If your answer is yes, why?</p>
<p>3.4 How affordable are the communication tools for CSA?</p> <p><input type="radio"/> Affordable</p> <p><input type="radio"/> Somewhat Affordable</p> <p><input type="radio"/> Not Affordable</p>
<p>3.5 Do gender roles in your household affect your access to CSA-related education and information?</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> I don't know</p> <p>If your answer is yes, why?</p>
<p>3.5 How does your Educational Level Impact your Understanding of CSA Messages?</p> <p><input type="radio"/> High Impact</p> <p><input type="radio"/> Moderate Impact</p> <p><input type="radio"/> Low Impact</p> <p><input type="radio"/> No Impact</p>

<p>3.6 Do you have access to extension workers?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul>
<p>3.7 If yes, how many kilometers do extension workers travel to provide you with CSA information?</p> <ul style="list-style-type: none"> <li><input type="radio"/> &lt; 1</li> <li><input type="radio"/> 1-5</li> <li><input type="radio"/> 5-10</li> <li><input type="radio"/> &gt;10</li> </ul>
<p>3.8 Does your social status in the community affect your access to CSA communication and education initiatives?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>Give reasons for your answer.....</p>
<p>3.9 Does the presence of farmer organizations or cooperatives in your area improve your access to CSA education?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>Give reasons for your answer.....</p>
<p>3.10 Is Language a Barrier to Your Understanding of CSA Communication?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>If your answer is yes, why?</p>
<p><b>4.0 Impact of CSA communication and education initiatives on farmers' resilience to climate shocks and extremes</b></p>
<p>4.1 To what extent has your resilience to climate shocks improved since receiving CSA-related information?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Significant Improvement</li> <li><input type="radio"/> Moderate Improvement</li> <li><input type="radio"/> Little Improvement</li> <li><input type="radio"/> No Improvement</li> </ul>
<p>4.2 Has CSA Education Improved your Farm Productivity During Climate Extremes like floods or droughts?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>If your answer is yes, why?</p>
<p>4.3 How Frequently Do You Implement CSA Practices?</p> <p>Daily      Weekly      Monthly      Yearly</p>
<p>4.4 What Impact does Timely Climate Information have on your Farming Decisions?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Very Helpful</li> <li><input type="radio"/> Helpful</li> <li><input type="radio"/> Neutral</li> <li><input type="radio"/> Unhelpful</li> </ul>
<p>4.5 Do you feel better prepared for future climate-related risks due to CSA training and education?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>Give reasons for your answer.....</p>

<p>4.6 How has CSA Communication Impact the Diversification of your Farming Techniques?</p> <ul style="list-style-type: none"> <li><input type="radio"/> High Impact</li> <li><input type="radio"/> Moderate Impact</li> <li><input type="radio"/> Low Impact</li> <li><input type="radio"/> No impact</li> </ul>
<p><b>5.0 CSA communication and education initiatives and its different impacts on men and women's adoption of CSA practices in CRR</b></p>
<p>5.1 What is the Frequency of CSA Program Participation by Men vs. Women?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Men more often</li> <li><input type="radio"/> Women more often</li> <li><input type="radio"/> Equal participation</li> </ul> <p>Give a reason for your answer.....</p>
<p>5.2 Does Gender-Based Barriers Limit Your Access to CSA Training?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>If your answer is yes, how?</p>
<p>5.3 Do men and women have equal CSA Support from Extension Officers?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>Give reasons for your answer.....</p>
<p>5.4 Who makes decisions concerning CSA Adoption in your household??</p> <ul style="list-style-type: none"> <li><input type="radio"/> Husband alone</li> <li><input type="radio"/> Wife alone</li> <li><input type="radio"/> Jointly</li> </ul>
<p>5.5 Do you think men have more Access to CSA Communication Tools (e.g., Phones, Radios) than women?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>Give reasons for your answer.....</p>
<p>5.6 Are CSA Trainings Tailored to Gender-Specific Needs?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul> <p>If your answer is yes, why?</p>

## **APPENDIX II: Interview Guide to the Focus Group Discussion and Key Informant Interview**

### **Section A**

#### **KEY INFORMANT INVIEW-General**

1. Can you please introduce yourself, your workplace, and your length of service?
2. How is the government involved in the promotion of Climate-Smart Agriculture (CSA) in The Gambia, particularly in the Central River Region?
3. What policies are currently in place to support sustainable farming in this region?
4. How does the government communicate climate change risks and CSA practices to farmers?
5. What challenges does the government face in implementing CSA programs?
6. What opportunities exist for improving communication and education related to CSA in this region?
7. What is your role in supporting farmers in the adoption of Climate-Smart Agriculture (CSA) practices?
8. How do you communicate with farmers about climate change and CSA?
9. What are the main barriers that farmers face in adopting CSA practices?
10. How effective are the current education programs related to CSA?
11. What recommendations do you have to enhance CSA communication and education?

## **Section B**

### **FOCUS GROUP DISCUSSIONS - General**

1. What do you think about the rainfall trend is increasing or decreasing?
2. What is your perception about climate change? Do you think it is real?
3. What are the key farming practices you currently use, and how do they help you to adapt to the impacts of climate change challenges?
4. Are you familiar with the concept of Climate-Smart Agriculture (CSA)? If yes, how did you learn about it?
5. How has climate change affected your farming activities in recent years?
6. What forms of support or training have you received regarding CSA or sustainable farming?
7. Do farmers benefit from any form of safety nets during situations of extreme weather events like floods and droughts to enhance their resilience?
8. Do you have any traditional ways of spreading information on CSA? If yes, how do you go about it and how effective is it?
9. How does the availability of transportation to educational centers or field schools impact your access to CSA knowledge?
10. How do you currently receive information on Climate-Smart Agriculture (CSA) practices? And which communication channel (e.g., radio, extension workers, mobile apps) do you find most effective in learning about CSA?
11. How affordable are the communication channels (e.g., mobile phones, radio) that disseminate CSA information for you?
12. Do you think that the educational level of farmers influences their ability to understand CSA messages shared through different channels?
13. Do you think that the educational level of farmers influences their ability to understand CSA messages shared through different channels?
14. Do you people have enough access to the Early Warning System for your farming activities?
15. What improvements would you like to see in the education and communication about CSA?

## **Section C**

### **Specific for Women Farmers**

1. What challenges do women farmers face in adopting Climate-Smart Agriculture?
2. How accessible is training and support on CSA for women farmers?
3. Does your marital status affect your access to CSA information and education?

## **Section D**

### **Specific for Villages Leaders (Alkalos and VDCs)**

1. How has climate change impacted your community, particularly in terms of farming and food security?
2. What role do local leaders play in encouraging sustainable farming practices in the community?
3. How can local leadership improve the communication and adoption of CSA practices?

## **Section E**

### **Specific for Young People**

1. Have you been involved in any projects or initiatives related to sustainable farming or climate change awareness?
2. How aware are young people in your community of climate change and its impact on farming?
3. What are the most effective ways to communicate with young people about sustainable farming and climate-smart agriculture? (Social media, community meetings, etc.)
4. Are there any campaigns or educational programs you have been part of that target youth and farming practices?
5. What challenges do young farmers face in implementing climate-smart practices? (Financial, educational, cultural?)
6. What tools, training, or resources would help you as a youth leader to promote climate-smart agriculture among your peers?
7. What recommendation do you have to enhance CSA communication and education among young people?

## **Section F**

### **Specific for NGOs**

1. Can you describe the role your organization plays in promoting Climate-Smart Agriculture (CSA) in the Central River Region?
2. How do you collaborate with local farmers and government bodies in delivering CSA-related programs?
3. What educational materials or training do you provide to farmers regarding CSA?
4. What challenges have you encountered when communicating CSA principles to rural communities?
5. How can NGOs better support resilience-building and sustainable farming through education and communication?

## **Section G**

### **Specific for religious leaders**

1. How do you view the relationship between faith, environmental stewardship, and farming?
2. In what ways do you currently communicate about environmental responsibility and climate change to your congregation?
3. How do you think religious leaders can contribute to raising awareness about sustainable farming and climate-smart agriculture?
4. Can religious institutions play a role in educating the community on climate change and farming practices? How?

**APPENDIX III:** Flood prevention dikes at Wassu Rice fields, CRR



**APPENDIX IV: Flood impacts in Kuntaur Rice fields, CRR**



**APPENDIX V: Interview with women gardeners in Sukuta, CRR**

