FACTORS AFFECTING ADOPTION OF CLIMATE CHANGE RESILIENCE STARTEGIES BY SMALL HOLDER FARMERS IN KWAPA SUB COUNTY IN TORORO DISTRICT EASTERN REGION

BY

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BU/UP/2021/1526

A RESEARCH PROPOSAL SUBMITED TO THE DEPARTMENT OF GEOGRAPHY FACULTY OF SCIENCE AND EDUACTION IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR'S DEGREE IN SCIENCE AND EDUCATION OF BUSITEMA UNIVERSITY

JANUARY, 2024

DECLARATION

I **AKIRAPA DOREEN REG. No. BU/UP/2021/1526 Hereby** Declare that the work presented in this research is my original work except where acknowledged, and it has never been submitted for any academic award in any institution of higher learning.

Signed……Date…22nd/04/2024.

AKIRAPA DOREEN

(Student)

APPROVAL

I certify that I have supervised and read this work and that in my opinion; it conforms to the acceptable standards of scholarly presentation and is fully adequate in scope and quality as a proposal in partial fulfillment for the award of degree of Bachelor of education with Science of Busitema University.

Signature ..... **Date** 27/6/2024

DR. TURYAHABWE REMIGIO

(SUPERVISOR)

DEDICATION

I dedicate this piece of work to my lovely mum, daddy and my friends who have always stood physically, emotionally and financially by my side during the period of writing this research.

ACKNOWLEDGEMENT

I would like to thank the almighty God for granting me health, grace, love, care. I acknowledge my family, mummy, Dad Emukule Samuel and my friend who stood with me all the time.

I extend my sincere gratitude to Busitema University for imparting in me skills and knowledge that helped me to successfully write this research report.

I thank my supervisor, mentor and parent **Dr. Turhayabwe Remigio(HOD),mr Wamono Emma and finally mister Kayima Patrick for the technical guidance** for the tireless effort and guidance,in corrections during my research report work at every stage which were so much instrumental to the success of this research , May God bless you all.

I also acknowledge my friends and appreciate my classmates in the academic career of a bachelor's degree most especially Nandutu Atidah,Mirembe Martha,Onyang Raymond,Mafabi Nathan Wilson and Duasi Gerald for standing by my side during the course of writing the Research Report.

LIST OF ABREVIATIONS

SPSS:	Statistical Package for Social Science
ICZM	Integrated coastal zone management
(IPCC)	Intergovernmental panel on climate change
IEA	International energy agency
UNFCCC	United Nations convention on climate change
UNDP	United Nations development program
GHG	Green House Gases
SHF	Small Holders Farmer

ABSTRACT

The purpose of this study was to establish the factors that have encouraged for adoption of climate change resilience strategies by some small holder farmers in Kwapa Sub County in Tororo District. The objectives of the study included: To assess the factors that have encouraged adoption of climate change resilience strategies by some small holder farmers in Kwapa sub county, to find out factors that have limited adoption of climate change resilience strategies by some small holder farmers in Kwapa sub county, To find out strategies to enhance adoption of climate change resilience by some small holder farmers in Kwapa sub county. The study adopted a cross sectional study design. The sample size was 103 respondents which consisted of 66 household heads, 10 villages, 1 agricultural officer, 1 community development officer and environmental officer. Purposive and simple random sampling was used to select the respondents. The study relied mostly on primary data that was collected using questionnaires, interviews and observation methods. The quantities data were analyzed by tabulating and computing frequencies, percentages. Qualitative data was analyzed by coding and establishing common theme e according to the objectives of study that emerged in the process of interacting with participants. The findings show that most small holder farmers in Kwapa sub county 80% have not adapted to climate change resilience.

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CHAPTER ONE:

1.0 Introduction

This chapter presented the background of the study, statement of the problem, research objectives, research hypothesis and significance of the study, scope of the study, limitations and delimitations

1.1 BACKGROUND

Climate change resilience refers to the capacity of systems -communities, ecosystems, infrastructure to absorb shocks and stresses caused by climate change and continue functioning effectively,(Cutter, Susan L., et al.2008)

It involved preparing for and adapting to the impacts of climate change to reduce vulnerability and bounce back from disturbance. Building resilience involved the combination of strategies including enhancing adaptive capacities, strengthening infrastructures, diversifying livelihood, promoting sustainable practices and foster community engagement and preparedness. It was crucial for mitigating risks and ensuring sustainability in the face of ongoing climate challenges (Cutter, Susan L., et al. 2008)

Scientific evidence suggested that globally climatic conditions are changing mostly for the worst (CGLAR, 2012; Marin, 2010). Climate change was regarded as silent crisis because the effects of climate change were not immediately visible (Maponya, 2010) however climate change had changed weather patterns and increased the intensity and frequency of extreme weather events such as drought and floods which impact particularly on poor in developing countries.

Globally factors that had limited adoption of climate change resilience on small holder farmers were many and include socioeconomic factors. Social factors encompass small holder farmer's attitudes, behaviors, and knowledge gaps (Mercer,D.B,.Falcon2008). Economic limitations involved funding constraints and cost benefit analysis that dartered investment in adoption strategies (lobell., et al 2008). Environmental factors included ecosystem fragility and unpredictability of climate impacts (IPCC, 2014).

The scientific consensus on climate change had played a significant role in encouraging the adoption of climate change resilience by small holder farmers. The intergovernmental panel on climate (IPCC) a leading international body for assessing climate science had provided extensive evidence demonstrating the reality and severity of climate change on small holder farmers. (Lobell, D.B., et al 2008)

Increasing frequency and severity of climate change related events had served as a wakeup call for small holder farmers worldwide .Heat waves , droughts, floods , hurricanes and wild fires had become more frequent and intense due to climate change, for example hurricanes Katrina in 2005 exposed vulnerabilities in new Orleans flood protection systems and highlighted need for improved resilience measures .Increasing small holder farmer's awareness and engagement around climate change issues had been instrumental in encouraging the adoption of climate change resilience.

The development of policy and legal frameworks at national and international levels had encouraged the adoption of climate change resilience measures by small holder farmers. The United Nations frame work convention on climate change served as key for international treaty for addressing climate change. (UNFCC, 2015)

Africa as continent is particularly vulnerable to the impacts of climate change due to its reliance on agriculture, water resources and ecosystems. The effects of climate change were already being felt across the continent with rising temperatures, changing precipitation patterns, and more frequent extreme weather events such as drought, floods and storms. These events had led to losses in agricultural productivity, increased food insecurity and exacerbated existing vulnerabilities among small holder farmers in the region. (Thornton,P.K.,et al 2011)

In response to these challenges the African countries had been developing and implementing various strategies to build climate change resilience by small holder farmers. these efforts broadly categorized into the following areas, that is to say adoption and mitigation measures, investment in renewable energy, strengthening early warning systems, climate finance and capacity building, ecosystem –based approaches, (African union agenda 2023).

African countries like Ethiopia, Nigeria and South Africa had been increasingly focusing on developing and implementing climate change resilience strategies and several factors that had encouraged the adoption of these strategies by small holder farmers in Africa include the following.

Africa is highly vulnerable to impacts of climate change due to its geographical location and social economic conditions. The continent experiences the range of climate related challenges, including droughts, floods and desertification. These events had several implications for food security, water availability and overall economic stability. According to international panel on climate change (IPCC, 2014) Africa is projected to experience significant changes in temperature and precipitation patterns

The economic impacts of climate change on small holder farmers are substantial in Africa. The agricultural sector, which forms back bone of many African economies, is particularly susceptible to climate variability and extreme weather events.

International partnership and funding, Africa had been able to secure funding and support from international partners such as the Global Environment Facility (GEF, 1991) to provide support to small holder farmers, The Green Climate Fund (GCF, 2010) and adaption fund to implement climate change adoption and resilience projects for small holder farmers. The partnership had enabled the African countries to access the financial resources, technical expertise and knowledge sharing platforms to develop and implement effective change strategies.(Smith, J., et al 2018)

Climate change had a significant impact on east Africa, affected agriculture, water resources, health and ecosystems.as a result, there had been a growing need for climate change resilience in the region for small holder farmers. This essay would explore the challenges faced by East Africa in building resilience to climate change and the various strategies and initiatives being implemented to address these challenges by UNFCC (2007).

East African countries often lacked the financial and technical resources needed to implement effective climate change adoption and mitigation measures. This limitation made it difficult for them to address the complex challenges posed by climate change on small scale farmers.

Climate change affected not just individual countries but also entire regions. In East Africa, cross-border issues such as shared water resources, migration and regional security posed additional challenges to building resilience to climate change.

Climate change resilience strategies were crucial for East Africa due to the region’s vulnerability to climate-related risks such as droughts, floods, and food insecurity. Several factors contributed to the

adoption of climate change resilience strategies in East Africa by small holder farmers. These factors included:

East Africa was highly susceptible to the impacts of climate change due to its reliance on rain-fed agriculture and pastoralism by small holder farmers. The region's vulnerability to climate-related hazards had been a significant driver for the adoption of resilience strategies by small holder farmers (Ogalleh et al., 2002).

The economic impacts of climate change, such as reduced agricultural productivity and increased resource scarcity, had motivated governments, organizations, and small holder farmers in East Africa to adopt resilience strategies. A report by the World Bank (2015) highlighted how the economic costs of climate change had prompted action towards building resilience in the region.

The presence of supportive policies and effective governance structures played a crucial role in driving the adoption of climate change resilience strategies by small holder farmers in East Africa. Research by (Nyangena,W., et al 2015)) emphasized the importance of policy frameworks that promoted adaptation and resilience-building efforts at national and regional levels.

Advancements in technology had facilitated the adoption of climate change resilience strategies by small holder farmers in East Africa. For instance, the use of weather forecasting tools, drought-resistant crop varieties, and water management technologies by small holder farmers had enhanced the region's capacity to cope with climate-related challenges (ogalleh.,et al 2016).

Community Engagement, small holder farmer's participation and local knowledge systems had been instrumental in promoting the uptake of climate change resilience strategies in East Africa. Studies by underscore the significance of involving local communities in decision-making processes related to resilience-building initiatives. (Ochieng, J., et al 2017).

International Support and Funding International support from organizations such as the United Nations Development Programme (UNDP), World Food Programme (WFP), and various donor agencies had influenced the adoption of climate change resilience strategies in East Africa. These entities provide funding, technical assistance, and capacity-building initiatives to bolster resilience efforts in the region for small holder farmers.(UNDP, 2020).

Strategies and Initiatives for Climate Change Resilience in East Africa included the following, Early warning systems were crucial for informing small holder farmers about impending climate-related disasters, such as floods and droughts. By strengthening these systems, East African countries would better prepare for and respond to climate change impacts by United Nations Development Programme(UNDP,2020).

Encouraging sustainable agricultural practices, such as agro forestry and conservation agriculture, would help East African countries adopt to changing climate conditions and build resilience for small holder farmers in the face of climate change.(Philip K., et al 2010)

Enhancing water resources management: Effective management of water resources was crucial for addressing the challenges posed by climate change among small holder farmers. Initiatives such as the Nile Basin Initiative aimed to promote cooperation among East African countries in managing shared water resources. (Kimathi, M., et al 2019).

Strengthening the capacity of governments, communities, small holder farmers and individuals to address climate change was essential for building resilience. Sharing knowledge and best practices among East African countries could help accelerate progress in climate change adoption and mitigation, by the International institute for Sustainable Development (IFPRI, 2016).

Collaborating with international organization such as the African Development Bank and the United Nations could help East African countries access funding, technical assistance, and expertise to address climate change challenges faced among small holder farmers. (IFPRI, 2016)

In Uganda climate change poses a threat to the sustainability of food production among small scale rural communities that were dependent on rain fed agriculture. Understanding small holder farmers' adaptions and the determinants of their adoption strategies was crucial in designing realistic strategies and policies for agricultures development and food security. In Uganda, various climate change resilience strategies had been adopted which included; Community based adoption, which engaged local community's initiatives such as climate smart agriculture and sustainable land management (Ospaosbahr-et-al, 2011.). Early warning systems had been established to anticipate and mitigate climate related risks like floods and droughts (UNDP, 2017),(Nnabuuma-et-al, 2020).

Climate-smart agriculture (CSA) was a crucial strategy in Uganda's fight against climate change. CSA involved the integration of modern agricultural practices, traditional knowledge, and science to ensure food security, improve the resilience of livelihoods, and reduce greenhouse gas emissions. Some of the key components of CSA in Uganda included; Diversification of crop varieties; farmers were encouraged to grow a variety of crops, including drought-resistant and climate-resilient ones, to minimize the impact of climate change on their harvests. Conservation agriculture; this practice involved maintaining soil cover, minimizing soil disturbance, and diversifying crop rotations to improve soil health and reduce erosion. Integrated pest management, Climate-resilient livestock breeds; farmers were encouraged to adopt breeds that were more resistant to diseases, heat, and drought. (Katharina, et al 2015

Construction of small-scale water harvesting structures by small holder farmers: To store water during rainy seasons and make it available during dry periods, Uganda had invested in the construction of small dams, reservoirs, and rainwater harvesting systems. (Nigussie, et al., 2019).

Promoting water-efficient irrigation systems: The country was promoting the use of drip and sprinkler irrigation systems to minimize water wastage and maximize efficiency among small holder farmers. (Dida, G.O., et al 2015).

Developing climate-resilient infrastructure for small holder famers: Uganda was investing in climate-resilient infrastructure, such as flood-proof buildings and drought-resistant water supply systems.

In line with global efforts to reduce greenhouse gas emissions, Uganda had embarked on promoting renewable energy sources and energy efficiency measures :(Ntale,H.K., et al., 2021).

Expansion of renewable energy sources that is to say Uganda was investing in solar, wind, and hydro power to diversify its energy mix and reduce dependence on fossil fuels by small holder farmers.

The government was promoting the use of energy-efficient appliances, lighting, and vehicles to reduce energy consumption and greenhouse gas emissions among small holder farmers. (Nakayiwa, F.M., et al., 2020).

Climate change was a significant threat to the environment and human well-being in Kwapa Sub County. Implementing resilience strategies that address the unique challenges faced by small holder farmers in the area was crucial for ensuring the community's ability to adopt and thrive in the face of

changing climate strategies that address the unique challenges faced by the small holder farmers in the area is crucial for ensuring the community's ability to adopt and thrive in the face of a changing climate. Collaborative efforts among local governments, on-governmental organizations, and small holder farmers were essential for the successful implementation of these strategies. Promoting sustainable agricultural practices, such as crop diversification, conservation farming, and agro forestry, could help improve food security and reduced vulnerability to climate change. (Nabirye,S., et al., 2017). Developing and implementing effective water resource management strategies, such as rainwater harvesting, irrigation systems, and water conservation measures, could help ensure access to clean and reliable water. (Muhumuza,T., et al., 2008). , Building climate-resilient infrastructure, such as flood-proof buildings, early warning systems, and disaster-resistant roads, could help protect small holder farmers from the impacts of extreme weather events. (Obaa, B.B., et al., 2020), Engaging local communities in climate change adoption planning and implementation could help increase awareness, ownership, and effectiveness of resilience strategies by small holder farmers, (Nakayenga., et al., 2020).

1.2.0 BACK GROUND OF THE AREA OF STUDY.

1.2.1 PHYSICAL LOCATION.

Kwapa Sub County was part of the Tororo District, which was located in the Eastern Region of Uganda. It was one of the nine sub-counties in the district, covering an area of approximately 236 square kilometers and it lies within latitude 315 degrees north (1° 18' 54.00'' N) and longitude 34.379 degrees east (34° 22' 44.40'' E).The sub-county was bordered by several other sub-counties, including Malera to the north, Lwala to the west, and Mukongoro to the south. Kwapa Sub County had a population of around 23,300 people, with the majority of the residents engaged in agricultural activities (Tororo District Developmental Plan 2015)'.

1.2.2 SOCIO-ECONOMIC BACKGROUND.

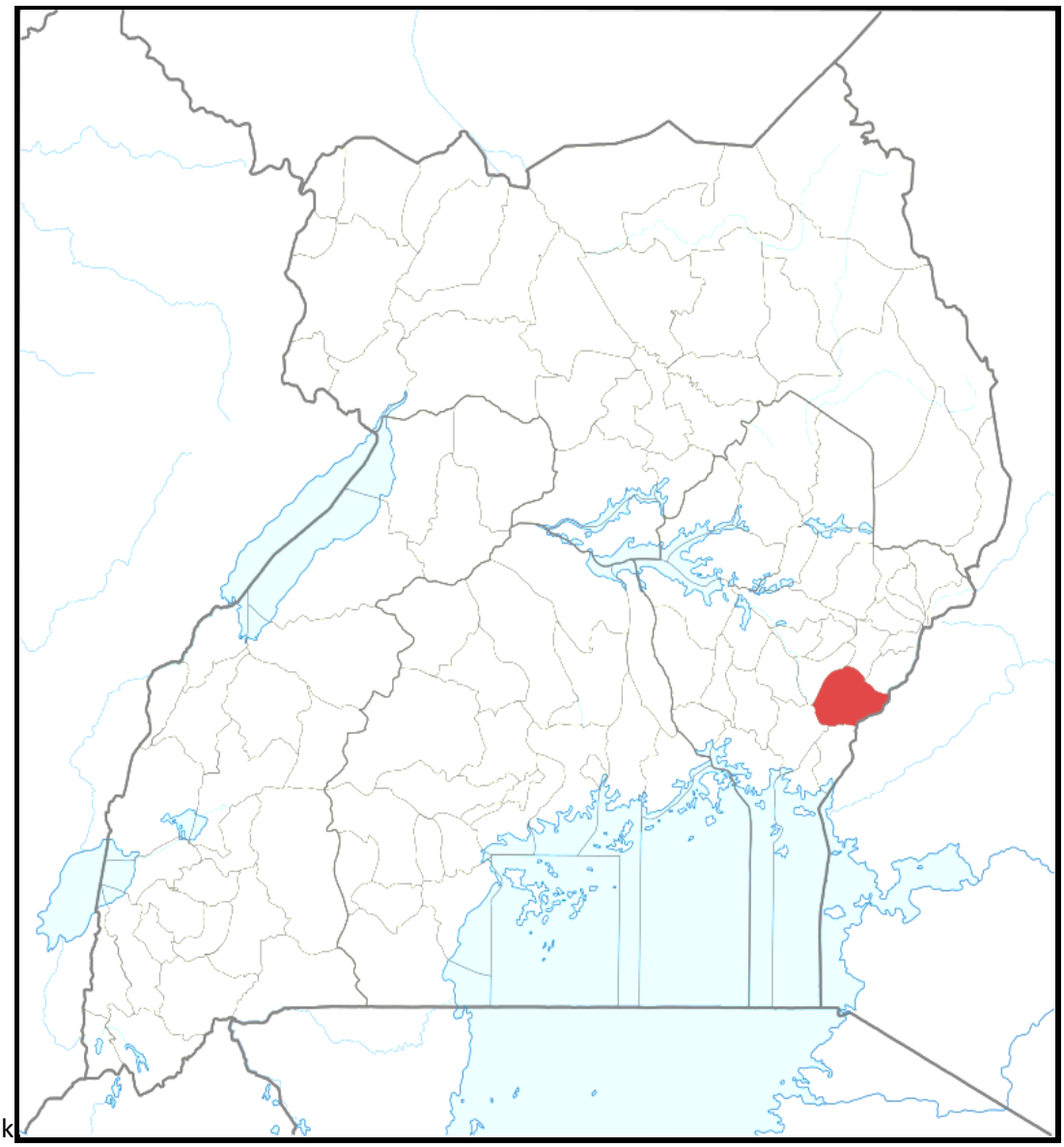
According to the Uganda bureau of statistics UBoS,(2014)it was estimated that kwapa sub county had a population of 23,300 with 11300 men and 12000 females where men 48.5% and females 51.5%.Kwapa Sub county, like many other areas in Uganda, had a diverse population with various ethnic groups and languages spoken that to say ateso as main language and lugisu ,kiswilli, japadhola.

The majority of the population in Kwapa Sub County was engaged in agricultural activities, with subsistence farming being the primary source of livelihood for many residents.

The economy of Kwapa Sub County was primarily agrarian, with agriculture being the main economic activity. The area was known for the cultivation of crops such as maize, millet, sorghum, and beans. Additionally, livestock rearing also contributed to the local economy. In terms of infrastructure, there are schools, health centers, and other essential facilities serving the population of Kwapa Sub County.

Land use	**Symbol**	**Easting's**	**Northings**	**Elevation**
Animal grazing Kwapa village	B1	34.25684	0.74392	1,263m
Rice growing	B2	34.0643	0.7619	1176m
Forest site(ogolai)	B3	34.0	0.6822	1100m

SKETCHMAP OF UGANDA SHOWING LOCATION OF KWAPA SUBCOUNTY



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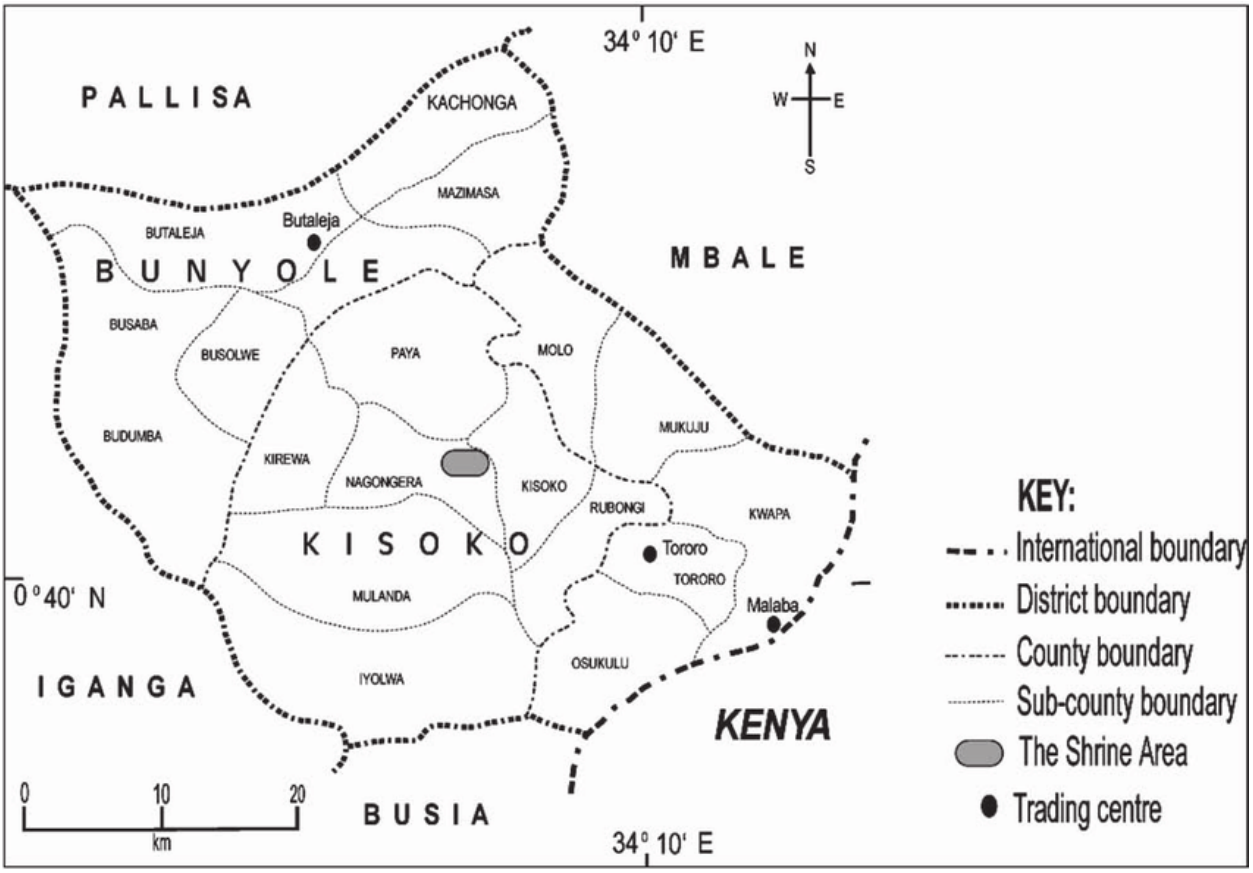
Scale

Area Land 1196.4km^2(461.9sqml)

Key

Kwapa Sub County

SHETCH MAP OF TORORO SHOWING LOCATION OF KWAPA SUB COUNTY



CLIMATE CHANGE

1.2.3 RELIEF.

The largest part of Tororo generally comprised of gentle slopes expects slopes where the district headquarters were located the largest part comprised of isolated hills like Osukuru hills and Tororo volcanic plug. Kwapa was generally comprised of a diverse topography that included both low lying areas and elevated regions and some of the relief features were plains, hills and wetlands

1.2.4. CLIMATE

The climate of kwapa Sub County was tropical that is wet and dry. It was characterized by high temperatures throughout the year and moderate rainfall tools. The rains were bio model flowing.

The area experiences a bimodal rainfall pattern, with the long rainy season occurring from March to May and the short rainy season from October to November. The average annual rainfall in Kwapa Sub County was approximately 1200-1400mm.

The temperature in Kwapa Sub County was relatively consistent throughout the year due to its proximity to the equator. The average annual temperature ranges from 25°C to 30°C. However, there may be slight variations in temperature between the wet and dry seasons the apparent overhead sun. The time of the sun also varies with the apparent movement of the sun. The humidity alternates and it's high in the wet season and low in the dry season

1.2.5 VEGETATION

Kwapa Sub County was a savannah area with grassland and scattered trees such as themeda trianda, hyparrhenia rufa. Most of the swampy vegetation was cleared to provide land for agriculture (rice growing) and settlement. These wetlands also provide habitats for numerous aquatics and semi aquatic plant species, such as water hyacinth (eichhonia crassipes) and duck weed (lemma spp.)

1.2.6 DRAINAGE

The drainage system of Kwapa Sub County was an essential aspect of its geography. The area was primarily drained by a network of rivers, streams 'and wetlands. The major rivers in the region include river Malaba and river manafwa, which played a significant role in the drainage of the subcounty.in addition to rivers, wetlands also played a crucial role in the drainage of kwapa Sub County. These wetland areas act as natural reservoirs for water, regulating the flow and distribution of water within the sub county. They also serve as habitats for diverse flora and fauna, contributing to the ecological balance of the region.

1.2.7 SOILS

Kwapa sub county had suitable fertile soils for example alluvial soils at deposited by river Malaba which was good for growing of various crops like beans, maize, cassava, and rice among others. These crops were staple food sources for the local population, providing essential nutrients and sustenance. The fertile soils also supported the growth of cash crops such as coffee, tea, cotton which contribute significantly to the region's economy. The soils were varying in type and characteristics. The vertosols in the lowland have agriculture. The soils were however heavy, deep, and fertile with the exception of sand mining where the soils were sandy and infertile.

1.3 Problem statement.

Climate change was a global phenomenon that poses significant challenges to various sectors, including agriculture, infrastructure, water resources and human health. As the impacts of climate change become more apparent. There was an increasing need for societies to adopt and build resilience to these changes. However, the successful implementation of climate change resilience strategies was influenced by various factors that can either facilitate or hinder adoption efforts. The problem statement focuses on identifying the key factors that affected the adoption of climate change resilience strategies. By understanding these factors, policy makers, organizations and communities can develop more effective and targeted approaches to address climate change Impact and enhance their adoptive capacity. The study was aimed at comprehensively assessing and analyzing the diverse array of social economic, environmental and institutional elements that impact the implementation and success of climate resilience strategies in various geographical contexts. By identifying and evaluating these factors this research will endeavor to provide actionable insights and recommendations to bolster the effectiveness of adoptive measures, thereby enhancing overall resilience to climate change impacts.

1.4 Purpose of the study

The purpose of the study was to find out the factors affecting adoption of climate change resilience strategies by small holder farmers in kwapa Sub County in Tororo district.

1.5 Objectives of the study

1.5.1 Main objective;

The factors affecting adoption of climate change resilience strategies by small holder farmers in Kwapa sub county in Tororo district.

1.5.2 Specific objectives

(i. To assess the factors that have encouraged adoption of climate change resilience strategies by some small holder farmers in Kwapa sub county

(ii. To find out factors that have limited adoption of climate change resilience strategies by some small holder farmers in Kwapa sub county.

(iii. To find out strategies to enhance adoption of climate change resilience by some small holder farmers in Kwapa sub county.

1.6 Research questions:

i. What are the factors that have encouraged for adoption of climate change resilience strategies in Kwapa Sub County?

ii. What are the factors that have limited for adoption of climate change resilience strategies in Kwapa Sub County?

iii. What are the strategies that have been undertaken by small holder farmers to enhance adoption of climate change resilience strategies in Kwapa Sub County?

1.7 Significance of the study

The study findings was of great help to the small holder farmers as it; provided the farmers with tailored strategies to cope with the impacts of climate change, it was to identify region specific challenges and offers practical solutions such as crop diversification, water management techniques and improved farming practices i.e. by implementing this measures, small holder farmers could enhance their ability to withstand extreme weather events, ensure food security and maintain sustainable lively hood despite the changing climate (Ospaosbahr-et-al, 2011).

The findings from the study are also bound to benefit the sub county by helping strengthen the adaptation strategies and the authorities by helping them understand the different forms of mitigation measures thereby developing emergency policies and climate resilience strategies. The significance of this study was that could contribute to new knowledge about mitigation measures induced by climate change and the relationship between climate change resilience strategies and the environment

1.8 Justification of the study.

Climate change resilience strategies were essential for mitigating the diverse impacts of climate change on human, social and economic systems. These strategies aimed to reduce vulnerability, enhanced adaptive capacity and facilitated the recovery of affected communities and ecosystem.The study was a great reference tool for policy implementers; farmers to bring about a collective effort to implement the proactive measures required to improve small holder farmers resilience to the impacts on their livelihood.

1.9 Limitation of the study

The researcher anticipated to be limited by time as it could not be ably enough for her to carry out the research and exhaust the different resources in her reach, unfavorable weather, shortage of funding to

access the place of study as well as access resources, in accessibility of some small holder farmers or respondents due to poor transport networks. Biasness by some respondents who were unwilling to provide the necessary and adequate information required

1.9. Delimitations of the study

To overcome the limitation anticipated during the study, the researcher could lobby for funds from friends and family, availing herself with necessary equipment to guard against damages caused by unfavorable weather such as umbrella, gumboots, jackets, rain courts, among others, planning for the available time appropriately to cope up with the limited time available to accomplish the study, developing a good rapport with the respondents and assuring them that the purpose of the research could be purposely for academic not anything else so as to build confidence in them and bury their worries complete.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter will look at the existing literature on the climate change resilience strategies, factors that have encouraged for adoption of climate change resilience strategies by small holder farmers, factors that have limited for the adoption of climate change resilience strategies and the strategies to enhance climate change resilience.

2.1 Climate change resilience.

Climate change resilience refers to the capacity of systems - communities, ecosystems, infrastructure to absorb shocks and stresses caused by climate change and continue functioning effectively. (Adger, W.N., et al 2005)

It involves preparing for and adapting to the impacts of climate change to reduce vulnerability and bounce back from disturbance. Building resilience involves the combination of strategies including enhancing adaptive capacities, strengthening infrastructures, diversifying livelihood, promoting sustainable practices and foster community engagement and preparedness. It's crucial for mitigating risks and ensuring sustainability in the face of ongoing climate challenges in (IPCC, 2021)

2.2 Climate change resilience strategies carried out by some small holder farmers.

Climate change resilience strategies involve actions and plans aimed at helping communities, ecosystems and infrastructure adapt to and withstand the impacts of climate change, Schlenker W, Lobell DB (2010).

They include measures like building resilient infrastructure, enhancing ecosystem resilience, implementing policies for disaster risk reduction promoting sustainable agriculture, developing early warning systems and fostering community engagement. Some of the climate change resilience strategies are discussed below;

Adoption and mitigation measures, adoption measures aim focus on adjusting to the current and future impacts of climate change, while mitigation measures aim to reduce greenhouse gas emissions and aim to slow down climate change by intergovernmental panel on climate change (IPCC)" climate change 2021: The physical Science Basis," In IPCC (2021)

Integrated coastal zone management (ICZM), this involves the sustainable management of coastal areas, taking into account the various environmental social and economic aspects. This approach helps to address the challenges posed by climate change, such as sea level rise and coastal erosion. (UNDPE, 2010).

Climate resilient infrastructure, Infrastructure should be designed and built to withstand the impacts of climate change such as floods, droughts and storms. This can include the use of green infrastructure like rain gardens and green roofs to manage storm water runoff and reduce urban heat island effects, (UNDRR, 2018).

Diversification of Crop, Small holder farmers can diversify their crop production to include a variety of crops that are resilient to different climate conditions. This can help mitigate the impact of climate variability on their agricultural productivity (FAO, 2017).

Implementing agroforestry practices can help small holder farmers improve soil fertility, water retention, and biodiversity on their farms, thereby enhancing resilience to climate change (World Agroforestry, 2020).

Small holder farmers can adopt water harvesting techniques such as building small dams, ponds, and rainwater harvesting systems to ensure water availability during dry periods (IFAD, 2019). Utilizing efficient irrigation methods such as drip irrigation or sprinkler systems can help small holder farmers cope with changing precipitation patterns and water scarcity (UNDP, 2018).

Implementing soil conservation measures such as terracing, contour ploughing, and cover cropping can help prevent soil erosion and maintain soil fertility in the face of extreme weather events (World Bank, 2020). Encouraging small holder farmers to adopt practices such as mulching and leaving crop residues on the field can improve soil moisture retention and reduce erosion (CGIAR, 2016).

Promoting the use of climate-resilient crop varieties that are tolerant to drought, heat, or flooding can enhance small holder farmers' ability to adapt to changing climatic conditions (Lobell,D.B.,et al 2011).

Implementing improved livestock management practices such as breed selection, feed management, and disease control can help small holder farmers maintain their livelihoods in the face of climate-related challenges (Herrero, M., et al 2009)

Enhancing access to timely and accurate weather information can enable small holder farmers to make informed decisions about their agricultural activities in response to changing weather patterns (Krupnik, T.J., et al 2016).

Providing training on climate-smart agricultural practices and technologies can empower small holder farmers with the knowledge and skills needed to adapt to climate change (Lipper, L., et al 2014).

Improving small holder farmers' access to financial services such as credit, insurance, and savings mechanisms can help them invest in climate-resilient technologies and cope with climate-related shocks (IFAD, 2020).

Supporting small holder farmers in diversifying their market options through value addition and accessing new markets can reduce their vulnerability to climate-related risks in agriculture (Harvey,C.A.,et al 2014).

Facilitating community-based adaptation planning processes can empower small holder farmers to collectively identify and implement resilience-building strategies tailored to their local context (Tschakert, P., et al 2010).

Promoting ecosystem-based approaches such as conservation agriculture and sustainable land management can enhance the resilience of small holder farming systems while preserving natural resources (CBD, 2021). Integrating disaster risk reduction measures into agricultural practices can help small holder farmers minimize the impacts of extreme events such as floods, droughts, and storms (Millennium Ecosystem Assessment.2005).

Ensuring that climate change resilience strategies take into account gender-specific vulnerabilities and empower women in decision-making processes related to agriculture can enhance overall resilience in farming communities (UN Women, 2020).

Advocating for policies that support climate-resilient agriculture and providing an enabling environment for small holder farmers through incentives and subsidies can facilitate the adoption of resilience strategies (FAO, 2021).

Establishing social safety nets such as cash transfer programs or food assistance schemes can provide a buffer for small holder farmers during periods of climatic shocks or agricultural losses (World Bank Group, 2020).

One of the local climate change resilience strategies is coastal protection. This involves the development and implementation of measures to safeguard coastal areas from the impacts of climate change such as storm surges, erosion, and sea-level rise. Examples of coastal protection methods include constructing seawalls, building dunes, and planting mangroves, "Sea-Level Rise and Coastal Flooding: Understanding and Managing Impacts on the United States" This report from the U.S.

Environmental Protection Agency (EPA) provides an overview of the potential impacts of sea-level rise and coastal flooding on the United States. It also discusses various coastal protection strategies that can be employed to mitigate these impacts.(Nicholls, R.J., et al 2020)

Green infrastructure is another local climate change resilience strategy that utilizes natural or nature-based elements to address various environmental challenges. It includes the use of vegetation, wetlands, green roofs, and permeable pavements to manage storm water, reduce urban heat islands, and improve air quality, "Green Infrastructure: Benefits, Applications, and Challenges" This publication by the United Nations Environment Programmes (UNEP,2010) discusses the benefits of green infrastructure, its applications in urban and rural areas, and the challenges associated with its implementation.(benedict, M.A et al 2006)

Urban greening involves the integration of green spaces into urban areas to enhance their resilience to climate change. It includes the planting of trees, establishment of parks, and the creation of green roofs and walls. Urban greening can help mitigate the urban heat island effect, reduce air pollution, and improve overall livability, "Urban Greening: The Role of Trees and Green Spaces in Combating Climate Change" This report from the International Union for Conservation of Nature (IUCN) examines the role of urban greening in mitigating climate change and enhancing urban resilience. It discusses the benefits of trees and green spaces in urban areas and provides recommendations for their incorporation into urban planning and design. (Wamsler et al., 2020)

Sustainable agriculture is a climate change resilience strategy that promotes environmentally friendly farming practices. These practices include crop rotation, cover cropping, and integrated pest management to improve soil health, conserve water, and reduce greenhouse gas emissions, "Sustainable Agriculture and Climate Change".(Thornton et al.,2020)

Proper waste management is essential for reducing greenhouse gas emissions and enhancing climate change resilience. Implementing waste reduction, recycling, and composting programs can help decrease the amount of waste sent to landfills, which release methane – a potent greenhouse gas, "Waste Management and Climate Change. (Kaza, et al., 2050)

Urban planning and design can be used to create more resilient cities that are better equipped to withstand the impacts of climate change. This involves incorporating green infrastructure, promoting

mixed-use development, and encouraging the use of public transportation, “Urban Resilience to Climate Change. (Revi, A., et al., 2014)

Disaster risk reduction is a key climate change resilience strategy that involves identifying and reducing the risks associated with natural disasters, such as floods, hurricanes, and wildfires. This can be achieved through hazard mapping, land-use planning, and the development of early warning systems.(UNISDR.(2015)

Local governments should develop climate change adoption and mitigation plans to identify vulnerabilities, set goals, and implement strategies to reduce greenhouse gas emissions and enhance resilience, “Adoption and Mitigation Planning for Climate Change. (Lapolongang , et al 2014)

Involving local communities in climate change planning and decision-making can help ensure that resilience strategies are tailored to the unique needs and vulnerabilities of different communities, “Community-Based Approaches to Climate Change Adoption. (Thomas, et al 2008)

International cooperation is essential for sharing knowledge, resources, and best practices in the development and implementation of climate change resilience strategies by the United Nations Research Institute for Social Development (UNRISD) examines the role of international cooperation in addressing climate change and the challenges and opportunities it presents for global governance.(Lea, et al 2015).Encouraging partnerships between government agencies, research institutions, NGOs, private sector entities, and farmer organizations can facilitate the co-development and dissemination of climate-resilient solutions for small holder agriculture (ICRAF, 2017).

2.3 Factors that have encouraged adoption of climate change resilience strategies by some small holder farmers

Small holder farmers are experiencing changes in temperature and precipitation patterns, leading to increased frequency of extreme weather events such as droughts and floods. These changes have necessitated the adoption of climate resilience strategies to mitigate their impact on agricultural productivity (Thornton et al., 2018).

Climate change has led to reduced crop yields due to heat stress, water scarcity, and increased pest and disease pressure. This has prompted small holder farmers to adopt resilience strategies to safeguard their livelihoods and food security (Lobell et al., 2011).

Small holder farmers are economically vulnerable to climate change impacts, as their livelihoods are heavily dependent on agriculture. The need to protect their income and assets has driven the adoption of climate resilience strategies (FAO, 2016).

Improved access to climate information and innovative technologies has empowered small holder farmers to implement resilience strategies such as drought-resistant crops, weather forecasting tools, and efficient irrigation methods (Bryan,E., et al., 2009).

Government policies and programs that promote climate-smart agriculture and provide financial incentives for adopting resilience strategies have encouraged small holder farmers to make these investments (FAO, 2017).

The demand for climate-resilient produce in domestic and international markets has incentivized small holder farmers to adopt practices that enhance the resilience of their agricultural products (Gbetibouo & Hassan, 2005).

Climate resilience strategies offer small holder farmers a means of managing risks associated with climate variability, thereby ensuring more stable agricultural production and income (Morton, 2007).

Collaborative approaches within farming communities have facilitated the sharing of knowledge and resources for implementing climate resilience strategies, fostering collective action among small holder farmers (Scoones et al., 2016).

Training programs and extension services focused on climate-smart agriculture have equipped small holder farmers with the knowledge and skills needed to adopt resilience strategies effectively (Lipper et al., 2014).

Climate resilience strategies often align with sustainable land management practices, promoting soil conservation, agroforestry, and biodiversity preservation among small holder farmers (Liniger et al., 2011).

Given the increasing water scarcity associated with climate change, small holder farmers have been motivated to adopt water-efficient irrigation systems and rainwater harvesting techniques as part of their resilience strategies (Rockström et al., 2017).

The availability of weather-indexed insurance products has provided small holder farmers with a safety net against climate-related crop losses, encouraging them to invest in resilience measures (Deressa,T.T et al., 2009).

Peer learning networks and farmer groups have played a crucial role in promoting the adoption of climate resilience strategies by facilitating knowledge exchange and mutual support among small holder farmers (Morton, J.F et al., 2007).

Climate change impacts on agricultural productivity can affect food security and nutrition, prompting small holder farmers to prioritize resilient farming practices for the well-being of their families and communities (Lobell, D.B., and Field, C.B.(2007).

Incorporating traditional knowledge and indigenous farming techniques into climate resilience strategies has resonated with small holder farmers, providing culturally relevant solutions to environmental challenges (Kiptot & Franzel, 2012).

Investments in research for resilient crop varieties, sustainable farming techniques, and climate adaptation measures have contributed to the uptake of these innovations by small holder farmers (Moser, S.C., et al., 2010).

Partnerships with NGOs, research institutions, and development agencies have provided small holder farmers with access to resources, expertise, and funding for implementing climate resilience strategies (Scoones, I., et al 2009).

Recognizing the differential impacts of climate change on men and women in agriculture, gender-responsive approaches have promoted the adoption of resilience strategies that address specific needs and vulnerabilities (Djoudi et al., 2016).

Climate-resilient farming practices enable small holder farmers to diversify their agricultural production, reducing dependence on single crops or livestock that may be susceptible to climate-related risks (Morton et al., 2009).

The economic incentives associated with climate change resilience have also encouraged its adoption. Investing in adoption measures can provide significant economic benefits by reducing the costs associated with climate related disasters. According to the report by the global mission on adoption, investing dollars 1.8 trillion globally in adoption measures from 2020 to 2030 could generate dollars 7.1 trillion in net benefits. Furthermore, many climate resilience strategies offer co-benefits beyond climate adoption. For example, implementing nature-based solutions such as restoring wetland or planting trees not only help to mitigate climate change but also provides additional benefits like improved water quality, enhanced biodiversity and recreational opportunities. (Andrew, et al 2013)

International agreements and frameworks have played a crucial role in encouraging the adoption of climate resilience strategies at a global level. The United Nations convention on climate change (UNFCCC) serves as the international forum for addressing climate change. Under the UNFCC, countries have agreed to work together to limit global warming and adapt to its impacts. The Paris adopted in 2015 sets a target of keeping global temperature raise well below 2 degrees Celsius above per-industrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius. (Steinar et al., 2017)

Local incentives and grass roots movements have been instrumental in driving climate change resilience strategies at the community level. Many communities around the world have recognized the importance of adapting to climate change and have taken action independently of national or international frameworks for example. Community led projects focused on sustainable agriculture; water management and disaster preparedness have emerged in various regions. These initiatives often involve collaboration between local government, civil society organizations and community members fostering a sense of ownership and empowerment (Adger et al., 2013).

Local governments play a crucial role in the development and implementation of climate change resilience strategies, When local leaders demonstrate commitment and leadership in addressing climate change, it small holder farmers to follow suit and adopt resilience strategies. When

communities are involved in the development and implementation of climate change resilience strategies, they are more likely to adopt and support these measures. Community engagement helps ensure that strategies are tailored to local needs and priorities, (Challinor et al., 2013).

Increasing public awareness and understanding of climate change and its impacts can encourage the adoption of resilience strategies by small holder farmers. Public education campaigns can help small holder famers recognize the need for action and the potential benefits of implementing resilience measures. (Leiserowitz et al., 2012). Increased awareness of the long-term implications of climate change on agriculture at global forums has influenced small holder farmers' decisions to invest in adaptive measures for building resilience in their farming systems (IPCC, 2014).

Access to accurate and up-to-date local climate data can help communities identify the specific risks and challenges they face due to climate change. This information can inform the development of tailored resilience strategies that are better suited to local conditions (Local Climate Data and Monitoring for Climate Change Resilience.

Emergency preparedness planning can help small holder farmers respond more effectively to the impacts of climate change. By developing plans and protocols for responding to extreme weather events and other climate-related emergencies, communities can better protect their residents and infrastructure. (Westley et al., 2013).

Ensuring social equity and justice in the development and implementation of climate change resilience strategies is essential for their success. By addressing the needs of vulnerable populations and promoting fair and equitable distribution of resources, small holder farmers can build more resilient and inclusive societies. (Aylett et al., 2013).

Knowledge sharing and capacity building can help small holder farmers learn from the experiences of others and develop the skills and expertise needed to implement climate change resilience strategies. By fostering collaboration and sharing best practices, small holder farmers can more effectively address the challenges posed by climate change.

Finally, the integration of climate change resilience strategies with broader development goals, such as poverty reduction and economic growth, can help small holder farmers ensure that these measures are

both effective and sustainable in the long term. By aligning resilience efforts with other development priorities, communities can build more resilient and prosperous futures (Lipper et al., 2014)

2.4. Factors that have limited for adoption of climate change resilience strategies by some small holder farmers,

Economic constraints are one of the primary factors limiting the adoption of climate resilience strategies by small holder farmers. Implementing resilience infrastructure and technologies by small holder farmers often requires substantial financial resources, which many developing and vulnerable small holder farmers lack the financial capacity to invest in climate resilience measures. According to the report by the UNDP economic constraints significantly hinder the implementation of climate change adoption measures, particularly in developing countries where financial resources are limited (UNDP, 2019). Without access to credit or savings, they may struggle to afford the upfront costs associated with adopting new strategies (FAO, 2016).

Lack of political will is another critical factor that hampers the adoption of climate resilience strategies. Political leaders and policy makers play pivotal role in driving climate action and allocating resources for adoption efforts. However, competing political priorities short term electoral cycles and vested interests can undermine the prioritization climate change resilience on national agenda. (IPCC, 2014).

Inadequate institutional capacities at local, national and international level poses significant barrier to implementing climate change resilience strategies. Weak governing structures, limited technical expertise and fragmented co-ordination among government agencies can hinder the development and implementation of effective adoption plans. (Berrang-Ford et al, 2011).

Technological limitations also limit the adoption of climate change resilience strategies by small holder farmers. Access to advanced technology such as early warning systems, climate modeling tools, innovative engineering solutions by small holder farmers is the essential for effective adoption. However, many regions especially in low-income areas lack access to these technologies due to cost barriers or insufficient technological infrastructures, (World Bank, 2020).

Social and cultural barriers are obstacles to implementing climate change resilience strategies. Traditional knowledge systems, social norms and cultural practices may conflict with modern adoption

approaches. Additionally, unequal gender diminishes and social inequalities in limit the participation of marginalized groups in decision making processes related to resilience planning. (Tschakert et al, 2013).

In some cases, small holder farmers and decision-makers may not fully comprehend the risks posed by climate change, leading to a lack of urgency in adopting resilience strategies. This inadequate risk perception can result in delayed action and insufficient preparedness (Smit et al., 2000).

The complexity of climate science and the uncertainty associated with future projections can create challenges for decision-makers in understanding and prioritizing climate change resilience strategies. This complexity may lead to inertia in taking proactive measures (Adger et al., 2003).

Many institutions and governments operate within short planning horizons, which may not align with the long-term nature of climate change impacts. This can result in a focus on immediate concerns rather than investing in adoptive measures for future resilience (Berrang-Ford et al., 2011).

Insufficient data and information on local climate impacts and vulnerabilities can impede the development and implementation of effective resilience strategies. Without accurate data, decision-makers may struggle to assess risks and prioritize adoption actions (UNFCCC, 2018).

Institutional barriers, such as conflicting policies, regulatory hurdles, and fragmented governance structures, can hinder the coordination and implementation of climate change resilience strategies across different sectors and levels of government (Pelling et al., 2008).

Socioeconomic disparities and unequal access to resources can exacerbate vulnerability to climate change impacts by small holder farmers. Marginalized communities may face additional barriers in adopting resilience strategies, perpetuating existing inequalities (O'Brien et al., 2006). In some cases, there may be perceived trade-offs between pursuing climate change resilience strategies and achieving other development goals such as economic growth or poverty reduction. This can lead to competing priorities that hinder the integration of adoption measures (Tol et al., 2005).

Lack of public awareness about climate risks and adoption options can undermine support for resilience initiatives. Effective communication and community engagement are essential for overcoming this barrier (Leiserowitz et al., 2009).

Inadequate legal frameworks or policy gaps related to climate change adoption can create uncertainties for investors, insurers, and local authorities, deterring proactive investments in resilience-building projects (Bulkeley et al., 2013).

Climate change impacts are often interconnected with other global risks such as pandemics or geopolitical conflicts. Addressing these complex interconnections requires coordinated action across multiple sectors and stakeholders, posing challenges for adoption efforts (IPCC, 2021).

Historical decisions and investments in infrastructure that are not resilient to current or future climate risks can create path dependence, making it difficult to transition towards more adoptive pathways due to sunk costs and entrenched systems (Davidson et al., 2016).

In many rural areas where smallholder farmers operate, there is a lack of essential infrastructure such as roads, storage facilities, and irrigation systems, which hinders the adoption of climate-resilient practices (World Bank, 2020). Smallholder farmers may lack the technical knowledge and skills required to effectively implement climate-resilient practices, such as conservation agriculture or agroforestry (World Bank, 2020).

Insecure land tenure can discourage smallholder farmers from making long-term investments in climate-resilient strategies, as they may fear losing their investments if they lose access to the land (World Bank, 2020).

Smallholder farmers may face challenges in accessing quality inputs such as improved seeds, fertilizers, and pest control technologies that are essential for implementing climate-resilient practices (FAO, 2016).

In regions facing water scarcity due to changing climatic conditions, smallholder farmers may struggle to implement irrigation-based resilience strategies effectively (FAO, 2016). Smallholder farmers often lack access to reliable climate information services that could inform their decision-making processes related to adaptation strategies (IFAD, 2013).

In regions affected by political instability or conflict, smallholder farmers may face additional challenges in accessing resources and implementing long-term resilience measures (World Bank, 2020). The lack of tailored research and development support for climate-resilient technologies

specifically designed for smallholder farming systems hinders their adoption of such innovations (IPCC

CHAPTER THREE: MATERIALS AND METHODS

3.0 Introduction

This chapter consists of research design, study area, study population, sample size determination and, sampling procedures, data collection tools and methods to be used in study.

To achieve the main aim and objectives of this research study the research will be conducted using questionnaires, interviews, to access the tools required for assessing the factors affecting adoption of climate change resilience strategies on small holder farmers in Kwapa Sub County.

Selection of respondents was done using multi-stage sampling with Sub County and household selection at different stages.

3.1 Research Design.

The study took a cross-sectional design; this research design was the most desirable because the study was meant to describe the factors affecting adoption of climate change resilience strategies on small holder farmers in Kwapa Sub County.

Surveys are well-known instruments that can be used to gather a lot of information in a short period of time. The study used both qualitative and quantitative research approaches. Qualitative approach was used as questions were asked and getting back feedback which was therefore recorded and presented in a descriptive way. Quantitative approach was used to reveal the numerical form of data such as statistics, percentages and so forth. It quantified the distribution and association of the variables. (Hair, J.F., et al 2019)

3.2 Target Population

A population refers to the total collection of elements about which the analyst wishes to make a few inferences (cooper and schindler 2013).the target population was "the entire aggregation of respondents that met the designed set of criteria.

Purposive sampling was particularly utilized to identify the small holder farmers who had adopted to the climate resilience strategies. The target population was generally regarded as individuals to participate in the study to be women, men, teenage girls and boys who are small holder farmers and residents of Kwapa Sub County.

3.3 Sample Size, sampling technique and sampling procedure

3.3.1 Sample Size

A sample consists of entities that are drawn on the entire study population with an intention of estimating the population characteristics (Siegel, 2003). Cooper and schindler (2003) put in plain words that sampling gives an idea when selecting several elements in a study population .in order that similar conclusions can be drawn concerning the complete population.

The sample size of this study comprised of 103 respondents i.e.3 Environmental officers in kwapa responsible for mitigating climate change and 100 residents in kwapa who live around kwapa Sub

County .It was assumed that 100 was the measure of the proportion of small holder farmers in kwapa sub county that were engaged in land use activities that contributed to climate change. The study adopted simple random sampling whereby each member of the subset had an equal opportunity of being selected.

Category	**Population (N)**	**Sample size (n)**	**Sampling Technique**
Small holder farmers in kwapa sub county	23,300	100	Simple random sampling
Environmental officers in kwapa subcounty	3	3	Purposive sampling
Total	23,303	103	

However the sample size was determined by category with the help of Taro Yamane formula given below:

N/1+Ne=n

Where n=the desired sample size

N=population size

E=maximum acceptable level of error

1=theoretical constant

3.3.2 Sampling Technique

The researcher used simple random sampling for sampling the smaller holder farmers as it gave each farmer an equal chance to be chosen to participate in the study. Purposive/Judgmental sampling which is a non-random sampling method was used to select the key respondents like local leaders, environment officer, and agricultural officers. This technique was used because it helped the

researcher to sample respondents based on her experience of knowledge of the group and in mind that these respondents had the information that she required.

3.3.3 Sampling procedure

Purposive sampling is a method generally utilized as part of subjective research for the ID and selection of information rich cases for the best use of confined resources (Patton, 2002).this incorporates perceiving and selecting individuals or social occasions of individuals that are especially taught about or experienced with a wonder of interest.(Creswell and Plano Clark 2011) .In this case, I determined the number of small holder farmers that were affected by climate change, and the strategies adopted by them with specific reference to kwapa sub county in Tororo district

3.4 Secondary data

Secondary data was gathered from the available documentation concerning the factors affecting the adoption of climate change resilience strategies on small holder farmers in Kwapa Sub County and Uganda at large. The sources of data included; books, journals, internet and newspapers among others.

3.5 Data collection methods

In order to address the objectives of the research, I used the following instruments in gathering and collecting data.

3.6.1 Interview method

This is done by researcher through face-to-face interaction or over the telephone. Interviews can be qualitative or quantitative .Qualitative involved open ended questions following the order of the design, this questions are spontaneous, loosely structured and sometimes protocol (interview guide).

Quantitative involved standardized (some questions are asked to everyone) close ended questions and telephone interview protocol (questions are similar for different people but read by the interviewer online).

3.6.2 Recording method

Recording method will involve use of mechanical tools and devices like smart phone, note book, pen and pencil to collect data. The data was analyzed and edited to come up with conclusions concerning factors affecting adoption of climate change resilience strategies in Kwapa Sub County.

3.6.3 Questionnaire method

According to Ary,D.,and Jacobs,L.C.(2009) questionnaires are pencil and paper instruments designed to gather information from individuals about their knowledge, attitude, beliefs and feelings. Questionnaires were issued to the selected respondents and these were small holder farmers mostly and it was made up of open and closed ended questions. The questionnaires were self-administered amongst the respondent

CHAPTER FOUR: DATA PRESENTATION, INTERPRETATION, AND ANALYSIS

4.0. Introduction

This chapter presents all the data collected during the study of the factors affecting adoption of climate change resilience strategies by small holder farmers in Kwapa Sub County in Tororo district, the data was collected by means of Questionnaire, interviews, Recording, and observation from the field

4.1 Climate change resilience strategies carried out by some small holder farmers in Kwapa Sub County.

To find out the strategies carried out by small holder farmers to overcome climate resilience strategies, respondents were asked to state the strategies under the guidance of questionnaire to the sub county officer, local leaders (sub county councilors and village chairpersons) which involved various questions and use of an interview guide to gather information from the natives . The results obtained were tabulated in the table 4.1.1 and further presented in in figure 4.1.2 for easy interpretation and comprehension.

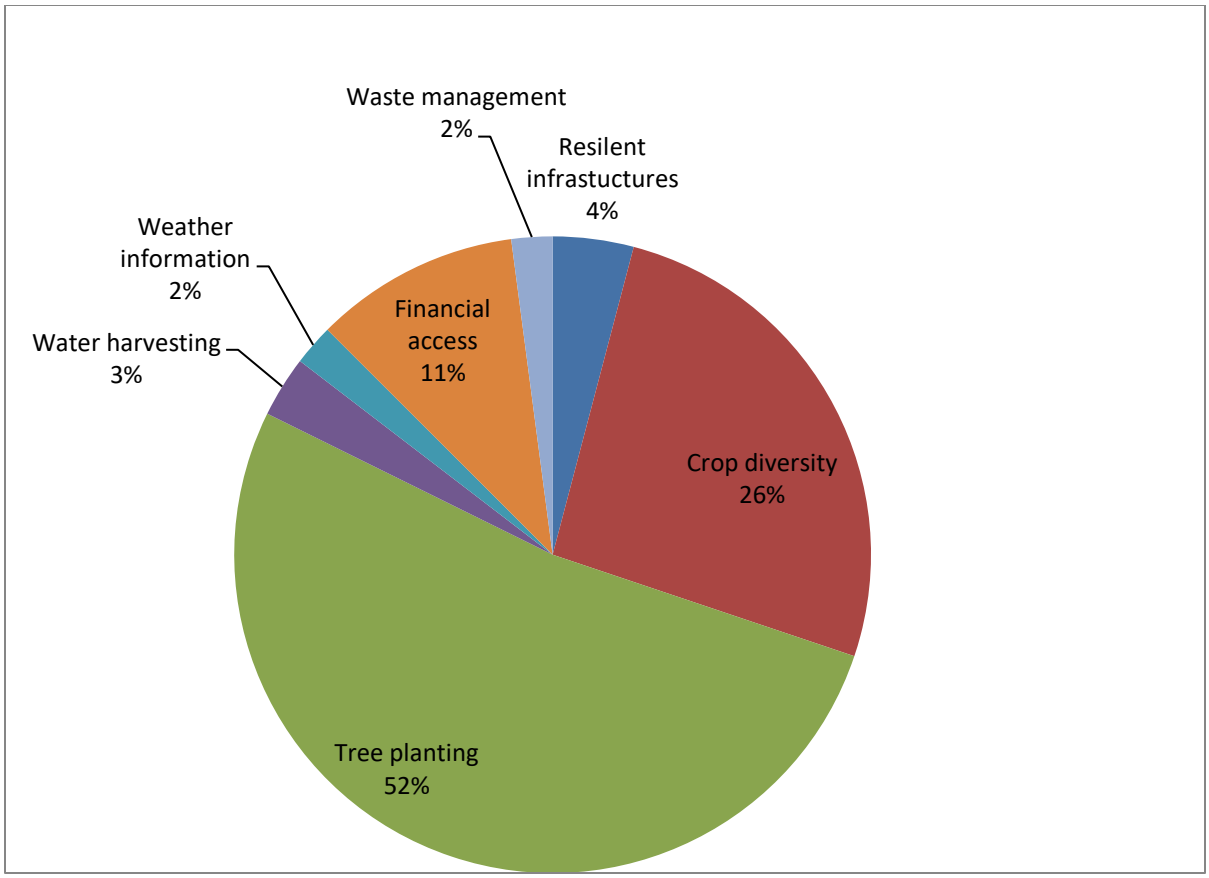
Table 4.1.1 summary of climate change resilience strategies and number of small holder farmers using such strategies

Strategy	Number of small holder farmers	Percentages
Resilient infrastructures	4	4.1
Crop diversity	25	26.04
Tree planting	50	52.1
Water harvesting	3	3.1
Weather information	2	2.08
Financial access	10	10.42
Waste management	2	2.08

Source; Research findings 19.03.2024

Table 4.1.1 reveals that 52% of the respondents were carrying out tree planting as strategy for climate change resilience in Kwapa Sub County. This therefore shows that there is need by government to encourage small holder farmers to adopt other climate change resilience strategies.

4.1.2 The pie chart showing the factors that have encouraged for adoption of climate change resilience strategies



Source; Research findings 19.03.2024

The findings from pie chart shows that most small holder farmers had adopted tree planting as the common climate change resilience strategy with 52% followed by crop diversity with 26% and financial access with 11%. The rest of the strategies that is to say waste management, weather information, building resilient strategies and water harvesting is still low.

Figure4.1.3 shows some of crops grown in kwapa Sub County by small holder farmers.

Source; Research findings 20.03.2024

4.2. Factors that have encouraged for adoption of climate change resilience strategies by some small holder farmers.

The researcher established the different factors for adoption of climate change resilience strategies by some small holder farmers in Kwapa Sub County as indicated below

Table4.2.1 shows Factors that have encouraged for adoption of climate change resilience strategies by some small holder farmers per village (N=96)

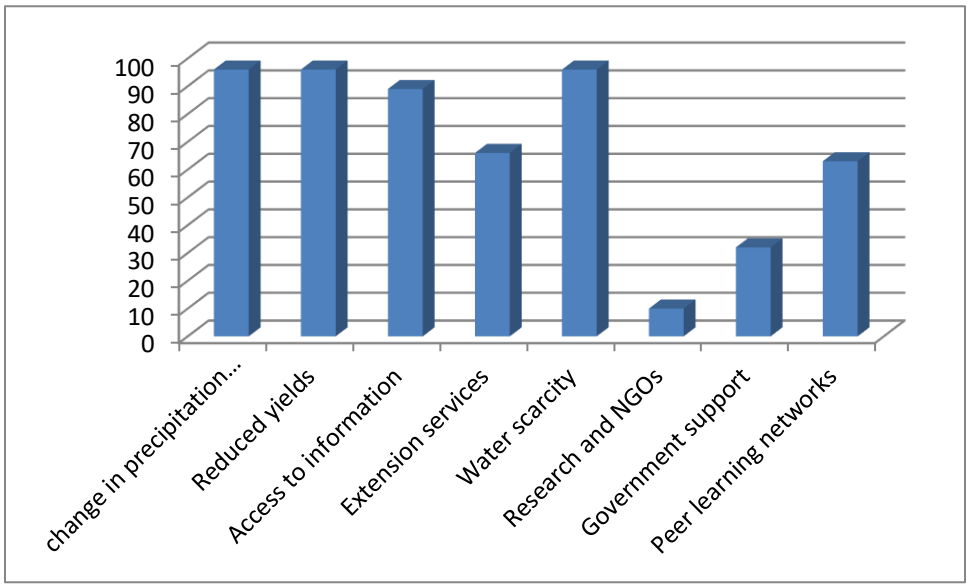
Village	**Factors that have encouraged adoption of climate change resilience strategies**							
	change in precipitation patterns	Reduced yields	Access to information	Extension services	Water scarcity	Research and NGOs	Government support	Peer learning networks
Komolo	2	10	6	3	10	0	5	0
Asinge A	6	12	10	0	10	0	6	5
Asinge B	5	10	22	0	10	0	9	10
Ogiroi A	8	23	8	10	12	3	0	9
Ogiroi B	10	8	10	16	10	2	0	9
Kwapa	9	7	7	10	10	0	3	8
Asuret	30	10	6	0	12	0	0	10

Apuwai	20	6	10	10	10	0	6	3
Mella	2	9	10	6	4	02	3	8
Amagoro	4	7	6	11	10	3	0	1
TOTAL	**96**	**96**	**89**	**66**	**96**	**10**	**32**	**63**

Source; Research findings 18.03.2024

Table4.2.1 reveals that most of small holder farmers were encouraged to adopt to climate change resilience factors such as change of precipitation patterns, reduced yields, water scarcity and access to information had high numbers of farmers motivated to adopt while research was the least factor encouraging farmers.

Figure 4.2.2 shows the factors that have encouraged for adoption of climate change resilience strategies by some small holder farmers.



Source; Research findings 20.03.2024

Figure 4.2.3 shows that change of precipitation patterns, reduced yields and water scarcity as the leading factors. Access to climatic information is the moderate factor and factors like government support, peer learning networks and research where the lowest in encouraging farmers to adapt to climate change resilience strategies.

Figure 4.2.4 shows the water dam in Asinge A village in Kwapa Sub County as sign that there is water scarcity from the area.

Source; Research findings 18.03.2024

4.2.5 Knowledge and experience about climate change.

Results show that 98.3%of the households have been affected by climate change and out of these; about 53.9% responded that the frequency of climate change has been a continuous throught out the year.

Majority 98.8% (98/100) had received climate change early warning information regarding their community. Mostly the modern methods of climate resilience strategies was said to be used in the community. Majority48.9%9 (48.9/100) lived near their farm lands and 6-10 kilometers from Tororo district headquarters. The household risk of climate change was high 77.7% according to most of the respondents. About 55.9% had their income affected and about 53.3% had had received low yields hence reduced food consumption at home. Majority 88 %(88/100) of the respondents reported that their crops were affected by disease outbreak like Potato wilt which affected their potatoes and cassava Mosaic disease which affected their cassava in the period of drought.

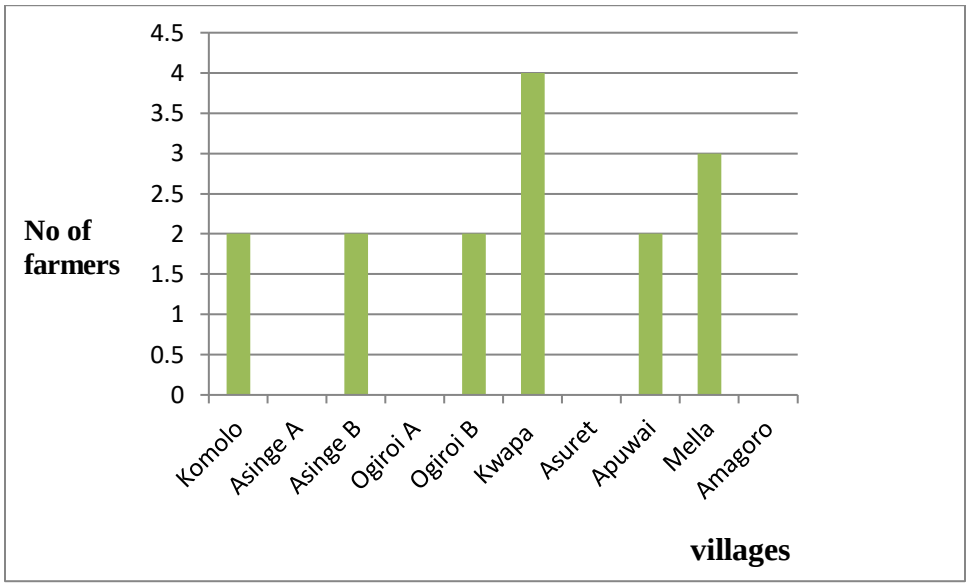
Table 4.2.6 showing knowledge about climate change resilience strategies in different villages

Name of village	Number of farmers with knowledge	Without knowledge
Komolo	10	2
Asinge A	10	3
Asinge B	7	2
Ogiroi A	10	0
Ogiroi B	10	2
Kwapa	10	4
Asuret	6	0
Apuwai	10	2
Mella	10	3
Amagoro	10	0
Total	96	18

Source; Research findings 19.03.2024

The table 4.2.6 reveals that most of small holder farmers have got knowledge about climate change resilience strategies in all villages I visited and very few farmers didn't know about climate change resilience strategies.

4.2.7 The column graph showing number of small holder farmers that have no knowledge about climate change resilience strategies in 10 villages of kwapa sub county.



Source; Research findings 18.03.2024

Figure4.2.8 shows some small holder farmers having climate change resilience strategies that is to say use of irrigation taps to solve water scarcity in A singe A village in kwapa Sub County.

Source; Research findings 20.03.2024

The small holder farmer in komolo village having irrigation scheme for his crops as shown in the diagram

Figure4.2.9 shows the use irrigation pipes during dry season to maintain crop variety.

Source; Research findings 18.03.2023

4.3 Factors that have limited for adoption of climate change resilience strategies by some small holder farmer

The study reveals that there are many factors that limited some small holder farmers to adopt to climate change resilience strategies in kwapa sub county and this included economic constraints, lack of political will, social cultural barriers, conflicting policies and regulations, lack of land, political instability, water scarcity, unequal access to resources, insufficient data, technological limitation and complexity of climate science.

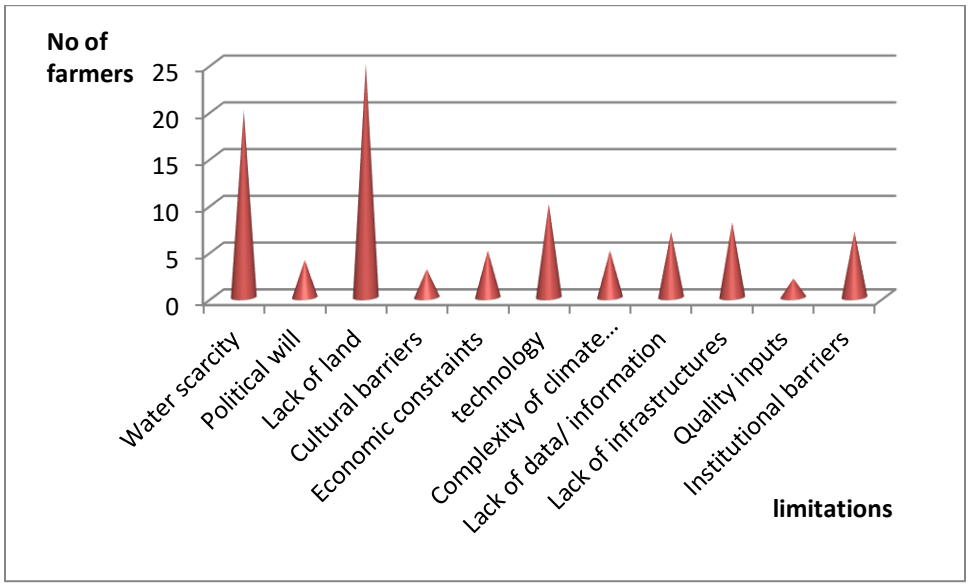
Table 4.3.1 showing the limitation factors for adoption of climate change resilience strategies

Limitation factor	Number of farmers
Water scarcity	20
Political will	4
shortage of land	25
Cultural barriers	3
Economic constraints	5
Technology	10
Complexity of climate science	5
Lack of data/ information	7
Lack of infrastructures	8
Quality inputs	2
Institutional barriers	7
Total	96

Source; Research findings 19.03.2024

The study revealed that water scarcity was 20.8% limiting factor by most farmers, political will had 4.2% of farmers, 26% of the farmers had problem of shortage of land, 3.1% of the farmers revealed that cultural issues limited their adoption ,5.2% of the farmers had economic constraints,7.3% of the farmers had institutional barriers,2.1% quality inputs,8.3% of the farmers had lack of infrastructure,7.3% of the farmers had lack of data/information,5.2% of the farmers had complexity of climate science,10.4% of the farmers had technological limitation

Figure4.3.2 indicates a column graph showing number of farmers against limitation factors for adoption of climate change resilience strategies in kwapa Sub County.



Source; Research findings 18.03.2024

The study revealed that 26% of the farmers had problem of shortage of land which had highest percentage followed by water scarcity with 20.8% as limiting factor by most farmers, 10.4% of the farmers had technological limitation, 8.3% of the farmers had infrastructure,7.3% of the farmers had lack of data/information, 7.3% of the farmers had institutional barriers, 5.2% of the farmers had economic constraints, 5.2% of the farmers had complexity of climate science, 4.2% of farmers had challenge of lack of political will, 3.1% of the farmers revealed that cultural issues limited their adoption, ,2.1% of farmers had lack challenge of lack of quality inputs as being the least

CHAPTER FIVE; DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction:

The chapter presents the discussion of the research findings, conclusions, and recommendations from the research findings of the study which was conducted in Kwapa Sub County in Tororo district.

5.1 Discussion.

5.1.0 Climate resilience strategies carried out by some small holder farmers in Kwapa Sub County

Construction of water sources, is one of the most common strategy carried out in kwapa sub county, 75 out of 96 respondents involved in the study of factors affecting adoption of climate change resilience strategies in Kwapa sub county revealed that there has been building of boreholes and a water dam as shown in figure 4.2.4 to help manage the high rates of water scarcity in kwapa during drought period. This is in agreement with (IFAD, (2019)

Diversification of crop species, is one of the strategy being carried out by some small scale holder farmers like I observed that 25 0ut of 96 farmers had cassava, Maize, Millet, potatoes in their gardens that were resilient to different climate conditions. This has helped small holder farmers in mitigating the impact of climate variability on their agricultural production.

Agroforestry practices are being carried out, 50 out of 96 small holder farmers involved in tree planting, 20% farmers involved in planting of grasses which helped them to improve soil fertility, water retention, and biodiversity on their farms, thereby enhancing resilience to climate change as it was written by (World Agroforestry, 2020).

Use of water harvesting techniques such as building small dams, ponds, and rainwater harvesting systems have been adopted to ensure water availability during dry periods, 3 out of 96 small holder farmers had been utilizing efficient irrigation methods such as drip irrigation or sprinkler systems as it was seen in Asinge A village which helped farmers to cope up with changing precipitation patterns and water scarcity during dry season in line with UNDP,(2018).

Access to timely and accurate weather information from government officials like agriculture officers, parish chiefs, community development officers enabled some small holder farmers like Mr Emojong

Henry in Komolo village to make informed decisions about their agricultural activities in response to changing weather patterns.

Access to financial services, such as credit, insurance, and savings mechanisms that helped them to invest in climate-resilient technologies and coped with climate-related shocks for example 10 out of 96 small holder farmers in kwapa had received parish development model money; this is in line with IFAD. (2020)

Diversification of market options, through value addition and accessing new markets which reduced on their vulnerability to climate-related risks in agriculture for example 5 out of 96 small holder farmers in Apuwai village sell their produce to Kenya through Malaba border as it's in agreement with (Harvey, C. A., et al 2014)

Facilitating community-based adoption planning processes has empowered 50% small holder farmers to collectively identify and implement resilience-building strategies tailored to their local context for example formation of SACCOs, tree planting.as said by (Tschaker, P., and et-al 2010)

Gender-specific vulnerabilities and empowered mostly women in decision-making processes related to agriculture which enhanced overall resilience in farming communities through taking leadership positions like chairperson local council five.

Providing Policies that supported climate-resilient agriculture and provided an enabling environment for some small holder farmers through incentives and subsidies for example 2 out of 3 environmental officers said that policies had been put in place which facilitated the adoption of resilience strategies like climate smart agriculture in the sub county.

Proper waste management which included biogas systems, rubbish pits, pit latrines was essential for reducing greenhouse gas emissions and enhancing climate change resilience as it was said by (Kaza.,et al 2005).2 out of 96 farmers visited were carringout waste reduction, recycling, and composting programs which helped to reduce the amount of waste sent to landfills, which released methane – a potent greenhouse gas.

Disaster risk reduction as one of a key climate change resilience strategy, 4 out of 96 farmers visited involved in identifying and reducing the risks associated with natural disasters, such as floods, drought, hailstorms and wildfires. This was achieved through hazard mapping, land-use planning, use

of micro scale irrigation, planting cover crops, faster growing crop species and tree planting as evident in the village of Akoret A in kwapa Sub County.(UNSDR,2015)

Climate change adoption and mitigation plans to identify vulnerabilities like diseases such as potatoes wilt, set goals, and implement strategies to reduce greenhouse gas emissions and enhance resilience, 10% of small holder farmers have been provided with tree seedlings, improved crop varieties that are resistant to climate change as the agricultural officer madam Nyabru Florence confirmed to me that the government has established irrigation scheme in the village of kaboosa.(Lapolongang.,et al 2014)

5.2 Factors that have encouraged adoption of climate change resilience strategies by some small holder farmers

Changes in temperature and precipitation patterns, such as drought and hailstones necessitated the adoption of climate resilience strategies to mitigate their impact on agricultural productivity in most of kwapa villages I visited like Asinge A had 6 farmers, Asinge B had 5 farmers, and komolo had 2 farmers among the ones I had visited. This is in line with (Tcornton et al 2018)

Reduced crop yields due to heat stress, water scarcity, and increased pest and disease pressure especially in villages of komolo with 10 farmers, Asinge A with 12 farmers, and Ogiroi A with 23 farmers. This had limited some small holder farmers to adopt resilience strategies to safeguard their livelihoods and food security, (Lobell et al 2011).

Improved access to climate information and innovative technologies had empowered some small holder farmers as evident in Kwapa village with 7 farmers and Mella with 9 farmers implemented climate change resilience strategies such as drought-resistant crops like cassava, millet, sorghum, and micro irrigation methods. (Bryan,E.,et al 2009).

Government policies and programs that promoted climate-smart agriculture and provided financial incentives like soft loans, build Africa saving groups to 32 out of 96 small holder farmers visited for adopting resilience strategies encouraged them to make these investments for example buying of water pumps, improved and faster growing seeds. This is in agreement with (FAO, 2017)

The high demand for climate-resilient produce in domestic and international markets encouraged 96 small holder farmers to adopt practices that enhanced the resilience of their agricultural products like tomatoes, potatoes, cabbage and cassava.

A means of managing risks associated with climate variability by some small holder farmers, thereby ensuring more stable agricultural production and income for example one farmer in Asinge B had micro irrigation which enabled him to produce outputs throughout the year for both home consumption and sell.In line with (Morton 2007)

Collaborative approaches used by 30% of the small holder farmers within farming communities that facilitated their sharing of knowledge and resources like capital, land into small portions, seeds for implementing climate resilience strategies, fostering collective action among them. This is in agreement with (Scoones et al 2016)

Training programs and extension services carried out by parish chiefs, environmental officers, agricultural officers(madam Nyabru Florence) focused on climate-smart agriculture that equipped 66 out 96 farmers interacted with had the knowledge and skills like use of biogas, solar, as sources of energy , needed to adopt resilience strategies effectively as written by (Lipper et al., 2014).

Adoption of micro water-efficient irrigation systems and rainwater harvesting techniques like use of tanks, watering canes, Adopted by 10 out of 96 small holder farmers as part of their resilience strategies, given the increasing water scarcity associated with climate change as evident in Amagoro B village in line with Rockstrom et al 2017)

Peer learning networks and farmer groups played a crucial role in promoting the adoption of climate resilience strategies by facilitating knowledge exchange and mutual support among the 63 small holder farmers in Kwapa Sub County as indicated in table 4.2.1.

Knowledge, Experience and indigenous farming techniques like use of organic fertilizers evident in Asinge A village was incorporated into climate resilience strategies that had resonated with 50% of small holder farmers, providing culturally relevant solutions to environmental challenges like drought, hailstones.(Kiptot & Franzel.,2012)

Partnerships with NGOs, research institutions, and development agencies provided 10 small holder farmers with access to resources like water, seeds, expertise like extension workers(Agricultural officer, vertinary officer) at the sub county, and funding from government incentives like PDM for implementing climate resilience strategies in agreement with (Scoones.,I.,et al 2009)

The differential impacts of climate change on men and women in agriculture had been recognized like 90% of women moved long distances looking for water for irrigation from the spring wells, dams, however, gender-responsive approaches promoted the adoption of resilience strategies that address specific needs vulnerabilities through involving both genders in decision making. (Dgoudi et al 2016)

Climate-resilient farming practices enabled 10 out of 96 small holder farmers visited to diversify their agricultural production, which reduced dependence on single crops or livestock that may be susceptible to climate-related risks for example one of the farmers had vegetable garden, fruit trees, cattle, sheep, chicken, turkeys in the village of Ogiroi in agreement with (Morton et al 2009)

Local incentives and grass roots movements have been instrumental in driving climate change resilience strategies at the community level. 96 farmers interacted with in Kwapa Sub County recognized the importance of adapting to climate change and had taken action independently for example. Community led projects focused on sustainable agriculture; water management and disaster preparedness had emerged in various villages like the dam constructed to supply farmers with water in their Gardens. These initiatives often involved collaboration between local government, civil society organizations and community members fostering a sense of ownership and empowerment in line with (Adger, et al 2013)

Local governments played a crucial role in the development and implementation of climate change resilience strategies for example it had created awareness to 32 out of 96 small holder farmers, 2 employed parish chiefs and 3 environmental officers, when local leaders like local council 1 demonstrated commitment and leadership in addressing climate change, some small holder farmers followed suit and adopted resilience strategies. Community engagement helped to ensure that strategies were tailored to local needs and priorities in line (Challinor. et al 2013)

Increased public awareness through church gatherings, public address systems, burial ceremonies, radio stations like rock mambo FM helped some small holder farmers to understand climate change and its impacts that encouraged the adoption of resilience strategies by some small holder farmers in Kwapa in villages of Apuwai, Asinge A,. Public education campaigns helped 89 small holder famers to recognize the need for action and the potential benefits of implementing resilience measures.(IPCC,2014)

Access to accurate and up-to-date local climate data from climatologists at the district has helped communities to identify the specific risks and challenges like drought that they faced due to climate change. This information was used to inform the development of tailored resilience strategies that were better suited to local conditions.

Emergency preparedness planning like water harvesting when it's in abundance 30% of small holder farmers respond more effectively to the impacts of climate change like drought, tree planting to act as wind breaks. By developing plans and protocols for responding to extreme weather events and other climate-related emergencies, some small holder farmers were able to protect their residents and infrastructure for example they created water channels to divert excess water, used water tanks for water harvesting, carried out contour ploughing in agreement with (Westley. et al 2013)

Benefits from social equity and justice in the development and implementation of climate change resilience strategies through involvement in decision making as it was essential for their success. It addressed the needs of vulnerable populations and promoted fair and equitable distribution of resources like funds, seeds, which made 50% of small holder farmers visited to build more resilient and inclusive societies in kwapa subcounty in line with (Aylett .,et al 2013)

5.3 Factors that have limited for adoption of climate change resilience strategies by some small holder farmers,

Economic constraints were one of the primary factors that limited 5 out 96 small holder farmers visited adopted climate resilience strategies. Implementing resilience infrastructure and technologies by small holder farmers often required substantial financial resources, where by many small holder farmers lacked the financial capacity to invest in climate resilience measures in villages of Kwapa village, Ogiroi A, Apokori all farmers are financially constrained. This is in agreement with (FAO 2016).

Lack of political will was another critical factor that hampered the adoption of climate resilience strategies. Political leaders and policy makers played pivotal role in driving climate action and allocating resources for adoption efforts. However, competing political priorities short term electoral cycles and vested interests undermine the prioritization in climate change resilience on national agenda since most leaders after voting them tend to mind their own business ignoring voters interests.(IPCC,2014).

Inadequate institutional capacities at local, national and international level posed significant barrier to 7 out of 96 small holder farmers visited to implement on climate change resilience strategies. Weak governing structures, limited technical expertise like environmental and climatologists and fragmented co-ordination among government agencies hindered the development and implementation of effective adoption plans hence making small holder farmers to fail to adapt to strategies.

Technological limitations also limited adoption of climate change resilience strategies by 10 out of 96 small holder farmers visited. Access to advanced technology such as early warning systems, climate modeling tools, innovative engineering solutions by some small holder farmers was essential for effective adoption. However, many farmers in Kwapa subcounty especially in low-income areas lacked access to these technologies due to cost barriers or insufficient technological infrastructures. (World Bank 2020)

Social and cultural barriers were also obstacles to 3 out of 96 small holder farmers visited to implement climate change resilience strategies. Traditional knowledge systems, social norms and cultural practices conflicted with modern adoption approaches. Additionally, unequal gender diminishes and social inequalities limited the participation of marginalized groups like the illiterate, elderly, disabled since they are not considered during decision making processes related to resilience planning.(Tschakert et., al 2013)

The complexity of climate science and the uncertainty associated with future projections created challenges for decision-makers in understanding and prioritizing climate change resilience strategies. This complexity led to inertia in taking proactive measures since 5out of 96 farmers I reached couldn't understand the ideas of climate change resilience strategies and all seemed new to them.in line with (Adger et., al 2003)

Many institutions and governments operated within short planning horizons, which didn't align with the long-term nature of climate change impacts. This resulted into focus on immediate concerns rather than investing in adoptive measures for future resilience for example most government climatic respond Programmes are implemented when disaster has occurred like floods, landslide hence making 7 out of 96 farmers to be at risk for example in villages of Aburet, Asinge A ,Komolo farmers crops were hit by drought due to poor climatic preparation by them for example water harvest, micro irrigation.(Berrang Ford et., al 2011)

Insufficient data and information on local climate impacts and vulnerabilities impeded the development and implementation of effective resilience strategies. Accurate data, decision-makers struggled to assess risks and prioritize adoption actions hence7 out of 96 small holder farmers in Kwapa sub county didn't receive any information concerning climate change resilience strategies.(UNFCCC,2018).

Institutional barriers, such as conflicting policies, regulatory hurdles, and fragmented governance structures, hindered the coordination and implementation of climate change resilience strategies across different sectors and levels of government for example most information in Kwapa sub county could remain at the sub county quarter and couldn't reach to the grassroots leaving the 7 out of 96 small holder farmers visited behind in line with (Pelling et., al 2008)

Socioeconomic disparities and unequal access to resources exacerbated vulnerability to climate change impacts by some small holder farmers. Marginalized communities of Ogiroi, Komolo, Aburet, Kaboosa faced additional barriers in adopting resilience strategies, with perpetuated existed inequalities. In some cases, there were perceived trade-offs between climate change resilience strategies and other development goals such as economic growth or poverty reduction. This led to competing priorities that hindered the integration of adoption measures.(Tol et., al 2005)

There was no public awareness about climate risks and adoption options hence undermined support for resilience initiatives. Effective communication and community engagement were essential for overcoming these barriers in Kwapa subcounty.(Leiserowitz et al 2009)

Lack of essential infrastructure such as roads, storage facilities, and irrigation systems, this hindered the adoption of climate-resilient practice. 8 out of 96 Smallholder farmers in Kwapa sub county lacked technical knowledge and skills required to effectively implement climate-resilient practices, such as conservation agriculture or agroforestry as in line with (World bank 2020)

Land shortage making it difficult to carry out better farming practices ,since land is limited especially 25 out of 96 farmers had one to half acres of land, and also land tenure system discouraged small holder farmers from making long-term investments in climate-resilient strategies, as they feared losing their investments if they lost access to the lands.

Difficulty in accessing quality inputs such as improved seeds, fertilizers, and pest control technologies that were essential for implementation of climate-resilient practices since 2 out of 96 farmers visited relied on locally available resources and inputs like seeds, use of bulls for clearing their gardens in villages of Kalait, Aburet, Ogiroi as in line with (FAO,2016)

Water scarcity due to changing climatic conditions, 20 out of 96 small holder farmers reached struggled to implement irrigation-based resilience strategies effectively since most of them with micro irrigation use shallow wells which cannot provide adequate water of farming activities in Asinge A, Asinge B, Ogiroi A, Komolo villages were heavily affected. Small holder farmers often lacked access to reliable climate information services that could inform their decision-making processes related to adoption strategies. (IFAD, 2013)

Political instability or conflict specially villages near the border towns like Malaba, some small holder farmers faced challenges in accessing resources and implementation of long-term resilience measures. There was lack of tailored research and development support for climate-resilient technologies specifically designed for small holder farming systems hindered their adoption of such innovations.

5.4 Conclusions

The study found out that some of the small holder farmers carried out climate resilience strategies like construction of infrastructures like the rain harvest tanks in Komolo village, water dam, wells, Establishment of diversity of crop species for example cassava, millet and potatoes, Implementation of agroforestry practices which included practices like tree planting, planting of grasses in the village of Ogiroi, Access to financial services such as credit, soft loans, Diversification of market options through value addition and accessing new markets, Disaster risk reduction which included identifying and reducing the occurrences, Community based adoption planning processes empowered small holder farmers to collectively identify and implement resilience building strategies,

Implementation of agroforestry practices by small holder farmers is the best strategy which has been lied down in Kwapa Sub County and it included tree planting, planting of grasses, planting of cover crops.

The study found out that some of the small holder farmers in Kwapa subcounty, adapted to climate resilience strategies due to changes in temperature and precipitation patterns which led to increased frequency of extreme weather events such as drought and hail stones, Their livelihoods were heavily

dependent on agriculture, Improved access to climate information and innovative technologies, Government policies and programs that promoted climate smart agriculture. There was high demand for climate resilient produce in domestic and international market, Training programs and extension services provided by extension workers that equipped them with information about climate smart agriculture, Research on resilient crop varieties, Sustainable farming techniques, Support from local governments, Emergence preparedness planning like water harvesting, Social equity and justice, establishment of micro water efficient irrigation scheme like Adam irrigation.

The study found out that factors that limited for adoption of climate resilience strategies by some of the small holder farmers included; Economic constraints for example like lack of financial resources, Lack of political will by some small holder farmers, Inadequate institutional capacities at local, national and international level, Technological limitations like establishment of irrigation schemes like water pipes, Social and cultural barriers, for example the social norms, agricultural practices conflicted with modern adoption approaches, Insufficient data and information on local climate impacts and vulnerabilities, Social economic disparities and unequal access to resources, Lack of public awareness ,Lack of access to quality inputs such as improved seeds, fertilizers, and pest control technologies, Water scarcity due to changing climatic conditions.

The most common hindrance is water scarcity due the changing climatic conditions in Kwapa sub county hence drought.

5.5 Recommendation

There is need to put emphasis on public awareness and mass communication through training of the village lc1, announcements on radios, church gatherings, conferences at local levels by the sub county officer and agricultural officer so that the small holder farmers are well equipped with the knowledge and information of climate resilience strategies.

Small holder farmers should adapt to modern methods of farming like use of tractors for ploughing, use of combined harvesters, use of improved fertilizers like NPK, caring out mixed cropping, irrigation, through establishment of more dams so as to improve on the quality of crop variety hence more demand and market for quality products.

The sub county officers should provide small holder farmers with agricultural farm inputs which enhance improved methods of farming such as irrigation equipment, High breed crops which take

shorter period of time to mature at asubstized cost. This will enable small holder farmers to cope with climate change impacts in Kwapa Sub County since high breed crops can mature before the onset of clouds.

The government should deploy more extension workers like agricultural officers, climatologists, weather forecasters so as to create more awareness to the public, and there is need to collaborate with non- government organizations to help farmers with inputs like irrigation equipment, construction of dams for water storage during scarcity.

Sub county authorities should provide farmers with soft loans to reduce on the rate of poverty hence growing of low value crops like cassava, millet, sorghum which earn them low incomes; farmers should involve in build Africa saving groups, strengthening government programs like(Parish development model) PDM, so as to enhance their incomes hence improved standards of living

The sub county officers through government should improve on the available infrastructure inform of roads or build more roads through allocation of money in road fund at the sub county so as to ease transportation of harvested crops to their homes as well as market centers for example Kwapa market ,and finished products from the manufacturing areas to the market .

There is need to improve on the available water sources like digging of more boreholes, establishment of mini dams for storage of water to reduce on movement for long distances by small holder farmers looking for water for domestic use and agricultural use for example Madam Atyang Martha aged 28years revealed that she moves for 2kilometres to the source of water hence she could not manage to water her crops during drought due to the long distances.

Tree planting campaigns should be embarked to reduce on high rates of deforestation for firewood, which is a source of energy by people; small holder farmers should use other alternative sources of energy like solar energy, biogas, paraffin stoves to reduce on cutting down of trees in their respective areas of settlement, this as well helps to conserve the local environment.

There is need to provide farmers with financial support to enable them hire land for agriculture especially in regions where most of small holder farmers own less than an acre of land which limits their farming practices, involving continuous use of land, leading to low output in terms of harvest, land conflicts in communities for ownership, land tenure system is also expensive. The sub county

worker should support farmers through the ministry of agriculture, and through the local government to provide them with better methods of agriculture like rearing of layers, piggery and nursery bed installation.

There is need to provide safety measures for example installation of warning systems, deploying care takers in gardens by the sub county authorities. As well as sensitization of communities to reduce on incidence of rampart theft of small holder farmer's crops in gardens especially when they are mature and ready for harvest like maize, cassava, cabbage, and avocado, as evidenced in the village of Asinge A where mister Emojong henry left home for two days and on his return, all the avocado fruits on the trees had been stolen.

5.4Areas for further study

A researcher is of a view that similar studies be carried out on factors for adoption of climate resilience strategies in other parts of Tororo district.

A researcher is of a view that studies to be carried out on the impacts of climate change

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Appendix

Questionnaires for the respondents

I would like to thank you all for taking your time to meet with me today. I am a student of Busitema university Nagongera campus currently carrying out research on factors affecting adoption of climate change resilience strategies on small holder farmers in Kwapa sub county, I would like to interact with you about the above subject matter

Questionnaire numbers……

Date……
……

(Tick the right option)

Sex

Male ☐

Female ☐

Age (how old are you?)

18-25 ☐

25-50 ☐

Residence

Resident (within Kwapa Sub County) ☐

Nonresident (outside Kwapa Sub County) ☐

Occupation ☐

Employed ☐

Self employed ☐

☐

Unemployed

Which type of crop is mainly grown?

Maize, beans ☐

Cassava, ☐

What factors have small holder farmers adopted to overcome climate change?

Use of alternative sources of energy ☐

Tree planting ☐

Mulching ☐

Early warning systems ☐

What are the alternative sources of energy?

Solar energy ☐

Energy saving bulbs ☐

Biomass energy ☐

Hydroelectricity ☐

Wind energy ☐

What factors have encouraged for adoption of climate change resilience strategies.

Gender ☐

Age ☐

Household size ☐

Farmer based organization ☐

☐

Farm size

Level of education

What factors have limited adoptation of climate change resilience strategies?

Lack of awareness and understanding

Lack of access to resources

Poverty and limited social economic development

Limited policies and regulations

Inadequate infrastructures and services