Advancing Agricultural Insurance in Uganda's Climate Change Adaptation: Determinants, Challenges and Opportunities for Insurance Uptake

Dissertation

Submitted to Carl von Ossietzky University of Oldenburg in Partial Fulfillment of the Requirements for Award of the Degree of Doctor of Philosophy in Economics

Submitted by

Fred Alinda

November, 2023

Oldenburg, Germany

First Supervisor	Prof. Dr. Bernd Siebenhüner
Second Supervisor:	Prof. Dr. Stefanie Sievers-Glotzbach
Place of Disputation:	Oldenburg-Carl von Ossietzky University of Oldenburg
Disputation date:	13.11.2023

Declaration of own work

I, Fred Alinda (immatrikulation number 6407587) hereby declare that this dissertation titled "*Advancing Agricultural Insurance in Uganda's Climate Change Adaptation: Determinants, Challenges and Opportunities for Insurance Uptake*" is my own work and that it has not been presented and will not be presented to any other university for similar or any other degree award. No commercial recruitment or consulting services were used in connection with this doctoral project. All sources cited or quoted in this dissertation have been indicated and acknowledged with a comprehensive list of references.

Oldenburg, 13.11.2023 ……

(Fred Alinda)

Declaration of Good Academic Practice

I declare that I have followed the guidance of good academic practice of the Carl von Ossietzky University Oldenburg (16.05.2023)

Oldenburg, 13. 11.2023 …….....

(Fred Alinda)

ACKNOWELEDGEMENT

I wish to extend my sincere appreciation to my supervisors Prof. Dr. Bernd Siebenhüner and Prof. Dr. Stefanie Sievers-Glotzbach all of Carl von Ossietzky University of Oldenburg. I remain humbled for their guidance, encouragement, trust and patience. It was my privilege working with them. In a special way, I thank Prof. Dr. Bernd Siebenhüner for the financial support in situations where I could almost get stuck. Without his effort and guidance towards my enrollment process in the university, my study aspirations would have remained a dream. It was quite a wholesome experience I will live to remember.

I extend thanks to Uganda Management Institute for partial sponsorship towards my PhD study. In the same way, I thank the Management Uganda Insurance Regulatory authority and the Agro-consortium not only for providing permission to undertake the beneficiary farmers under the Uganda Agricultural Insurance Scheme but also providing data which was quite useful informing the design and implementation of the study. Special thanks also goes to the Bududa district authorities for flagging off the study in the district. More thanks goes to the Management of the Agricultural insurance scheme at the Ministry of Finance Planning and Economic Development and all respondents who provided valuable data that informed the study.

Finally, my special gratitude goes to my beloved family for being there for me throughout my PhD journey. Their continued love, unwavering support, patience and encouragement created a conducive environment for me to fast-track the journey.

ABSTRACT

Agricultural insurance is highly underscored as a key enabling conditions for implementing, accelerating and sustaining climate change adaptation. Despite its significance, uptake of agricultural insurance remains low with limited empirical knowledge on particularly in the context of small holder farming communities more vulnerable to the climate risks. Leveraging on consumer behavioral theories and data from 350 smallholder farmers, logistic regression was applied and key informant interviews to assess the determinants, challenges and opportunities for uptake of agricultural and identifies measures for its effective mainstreaming as a climate change adaptation strategy. The study concludes that agricultural insurance is loosely mainstreamed in the climate change adaptation framework for Uganda. Its adoption is influenced by a strong nexus between demand and supply side constraints particularly the farmer and farm characteristics, funding, structural and institutional factors.

Key words: Agricultural insurance, climate change, adaptation, determinants, challenges, opportunities

Die Landwirtschaftsversicherung wird als wichtige Voraussetzung für die Umsetzung, Beschleunigung und Aufrechterhaltung der Anpassung an den Klimawandel hervorgehoben. Trotz ihrer Bedeutung ist die Inanspruchnahme von Agrarversicherungen nach wie vor gering und es liegen nur begrenzte empirische Erkenntnisse vor, insbesondere im Zusammenhang mit kleinbäuerlichen Landwirtschaftsgemeinschaften, die anfälliger für Klimarisiken sind. Unter Nutzung von Verbraucherverhaltenstheorien und Daten von 350 Kleinbauern wurden eine logistische Regression und Interviews mit wichtigen Informanten angewendet, um die Determinanten, Herausforderungen und Chancen für die Einführung der Landwirtschaft zu bewerten und Maßnahmen für deren wirksame Mainstreaming als Strategie zur Anpassung an den Klimawandel zu identifizieren. Die Studie kommt zu dem Schluss, dass die Agrarversicherung im Rahmen des Klimaanpassungsrahmens für Uganda lose verankert ist. Seine Einführung wird durch einen starken Zusammenhang zwischen nachfrage- und angebotsseitigen Beschränkungen, insbesondere den Merkmalen des Landwirts und des Betriebs, der Finanzierung sowie strukturellen und institutionellen Faktoren, beeinflusst.

Schlüsselwörter: Agrarversicherung, Klimawandel, Anpassung, Determinanten, Herausforderungen, Chancen

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYM AND ABBREVIATIONS

ACCI	Adaptation to Climate Change and Insurance
AI	Agricultural Insurance
ANOVA	Analysis of Variance
AEOs	Agricultural Extension Officers
ASSP	Agricultural Sector Strategic Plan
BOU	Bank of Uganda
CAO	Chief Administrative
CDMR	Commission on Disaster Management & Refugees
CSA	Climate Smart Agriculture
Df	Degrees of freedom
EAC	East African Community
FAO	Food Agriculture Organization
FG	Farmer Group
FSD	Financial Sector Deepening
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOU	Government of Uganda
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGC	International Growth Centre
IPCC	Inter-governmental Panel on Climate Change
LCIII	Local Council One
LCV	Local Council Five
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MOFPED	Ministry of Finance Planning and Economic Development
MOLHUD	Ministry of Lands Housing and Urban Development
MMR	Mixed methods research
MWE	Ministry of Water and Environment
n	Sample size
NDCs	Nationally Determined Contributions
NAP-Ag	National Adaptation Framework for Agriculture
NAADS	National Agricultural Advisory Services
NCCP	National Climate Change Policy
NDP	National Development Plan
NGOs	Non-governmental Organizations

NPA	National Planning Authority
OLS	Ordinary Least Squares
p	Probability value
S.E	Standard Error
SDGS	Sustainable Development Goals
Sig	Significance level
SSA	Sub-Saharan Africa
SPSS	Statistical Package for Social Scientists
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UBA	Uganda Bankers Association
UCA	Uganda Cooperative Alliance
UIA	Uganda Insurers Association
UN	United Nations
UNCCCS	National Climate Change Communication Strategy
UNFFE	Uganda National Farmers Federation
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WFP	World Food Program

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

1.1.1 The climate change problem in the agrarian context

Climate change remains a Global issue associated with extreme conditions like floods, droughts, and landslides which constrain development particularly in poor countries (UNDP, 2018; Williams, et al., 2018, IPCC, 2014). Climate trend projections indicate that climate has changed worldwide and will continue to change in the foreseeable future. Notwithstanding the international commitment to limit the global temperature rise to 1.5°C, global warming is projected to increase to this level between 2030 and 2052 unless the current trend of its increase is reversed (IPCC, 2018). In Uganda, human-induced climate change has been predicted to increase average temperatures up to 4.3 ºC by the 2080s. Such changes bear a detrimental impact on the country's natural resource base, agricultural production, and productivity potential and ultimately curtail growth and sustainable development (Ministry of Water and Environment, [MWE], 2018). Climate change is associated with extreme temperatures and rainfall which trigger more frequent and intense droughts and floods. It is also associated with spatial and temporal shifts in rainfall patterns.

Agriculture is one of the sectors most vulnerable to but also contributing to the changing climate (Eludoyin et al., 2017; Akinwumi, Adewumi & Obiora-Okekem, 2020; Singh & Hlophe, 2017). Extreme weather events pose a risk of low agricultural production and productivity or complete total loss in production, due to drought and extreme floods (Eludoyin et al., 2017; Akinwumi, Adewumi & Obiora-Okekem, 2020; Das, 2018). For example, FAO (2016) estimated that the global agricultural sector lost at least $39 billion between 2005 and 2014. This renders agriculture riskier and more unattractive for investment. In absence of utilization of effective adaptation strategies, farmers suffer heavy losses, sell or mortgage off their productive assets to survive, and lose a livelihood (Singh, 2017, Gettleman, 2017). In a long run, they lose their investment capital as financial institutions get reluctant to lend them. As a result, farmers are limited in their capacity to invest in improved and innovative agriculture methods (Thérèse et al., 2013).

In developing countries and particularly in Sub-Saharan Africa, the adverse impacts of climate change on agricultural production and productivity mean that climate change remains the biggest threat to food security and sustainable development (Campbell, 2022). The effects of climate change risks are even more disastrous for poor farmers in developing countries, where formal safety nets are absent or very limited (ND-GAIN, 2021). An unstable environment makes it impossible or very hard for them to escape the poverty trap (Eludoyin et al., 2017; Akinwumi, Adewumi & Obiora-Okekem, 2020). Moreover, the agricultural sector tends to produce less than its potential, with a negative impact on society in terms of growth and food security (Thérèse et al., 2013).

Uganda is one of the top 10 countries most vulnerable to climate change (World Bank, 2019). Like elsewhere in the world, Uganda's agricultural sector is more vulnerable to the climate change problem characterized by high risks of floods and landslides which lower agricultural production and productivity (World Bank, 2019; USAID, 2015; Bashaasha, Waithaka, & Kyotalimwe, 2012). The Ministerial statement by members of the Parliamentary Forum on Disaster Risk Reduction and Mitigation in partnership with the Civil Society Budget Advocacy Group and OXFAM Uganda's National Humanitarian Actors on floods (OXFAM, 2018) paints a picture of the intensity, frequencies, and adverse impacts of foods in Uganda between the period 2015 and 2018. The impact of climate change on the declining performance of Uganda's agriculture has been underscored by the UNFCCC report (MWE, 2018). Climate-induced yield losses are predicted to increase to a range of 50-75% by 2050.

Notwithstanding the adverse impacts of climate change on agriculture, the sector remains a major economic driver and a critical source of livelihood for 2.5 billion people worldwide (FAO, 2017). In agriculture-based economies, which include most of Sub-Saharan Africa, agriculture generates 29% to GDP and 94% of rural households live from their agricultural activities. GDP growth in agriculture is at least twice as effective in reducing poverty as non-agricultural GDP growth, and; productivity gains in agriculture are critical for self-sustaining economic development in most developing countries (World Bank, 2018). In Uganda, agriculture remains a significant contributor to GDP (24%), export revenues (about 48%) and a source of livelihood for over 70% of the population (MWE, 2018).

Consequently, the question of climate change adaptation in agriculture is quite paramount towards building resilience especially towards realization of the much-desired sustainable development (Campbell, 2022; Hellin, 2016).

1.1.2 Climate change adaptation and evolution of agricultural insurance

Owing to the impacts of climate change, the world has sustained commitment to address the climate change problem with emphasis on climate change adaptation (IPPC, 2018) notwithstanding the efforts towards mitigation. The commitment leverages on the notion that climate change is inevitable, what matters is the degree to which systems can adapt to become more resilient to the adverse impacts (UN, 2015; IPCC, 2018). Commitment to climate change adaptation was flagged off in the Paris Agreement in 2015 which committed to strengthening the global response to climate change by increasing the ability of all to adapt, build resilience, and reduce vulnerability (UN, 2015). Consequently, there is continued commitment at regional and national levels to promote climate change adaptation (IPCC, 2018).

The concept of adaptation has roots in the field of biology, where it was first used to refer to 'processes whereby a structure is progressively modified to have better performance in relation to its environment (Holland, 1998). It is the degree of coping with external impacts or new circumstances arising from perturbations. This definition emphasizes two fundamental aspects of adaptation that is: adjustment as a coping mechanism and improved performance in relation to environmental conditions as the primary purpose. Performance in the context of climate change adaptation concerns systems sustainability. For instance, Smit et al. (2006), defined adaptation to climate change impacts as 'adjustments in socio-economic systems in response to actual or expected climatic stimuli and their effects. impacts. Adaptation means that the system can survive adverse impacts of external perturbations or shocks created by climate change shocks such as floods, droughts, and landslides (Adger, 2006; IPCC, 2001). Building on these definitions, the IPCC (2014) report identifies how a social system can adapt by modifying or changing characteristics or actions to moderate potential damage, taking advantage of opportunities available. Adaptation can be viewed or assessed at individuals, households, communities, and organization levels (Smit & Pilifosova, 2006; Pelling, 2011).

Conventionally, many countries designed adaptation frameworks providing a diverse range of strategies to manage climate risks as a way of adapting to climate change. The strategies focus on risk avoidance and risk reduction. Examples of these risk management strategies are crop species/variety selection, crop breeding, enhanced crop rotation, intercropping and mixed farming, irrigation systems, fringe income, contract farming, savings and reserves, remittance, borrowing, and tax relief as well as 'futures markets', 'forward contracts' and 'policy covers". Despite the efforts toward promoting climate change adaptation, insufficient adaptation remains a problem particularly in Africa, the Small Island States, and the South. The low adoption has been attributed to insufficient adaptive capacity at individual and household levels (IPCC, 2018; Campbell, 2022; Williams, Crespo & Abu, 2019). It is observed that smallholder farmers in low-income countries lack the capacity to utilize conventional adaptation strategies yet financial institutions are adamant to finance climate change adaptation or technological innovations (Nnadi, 2013). Besides, the conventional adaptation strategies and local coping mechanisms have not been effective in minimizing the less intense or mild climate change risks. They also remain ineffective for catastrophic weather shocks. Hence, the most venerable barely have a chance to adapt and build resiliency to climate change (Omerkhil et al., 2020; Giri et al., 2021).

Agricultural insurance emerged as a viable alternative to complement the conventional climate change adaptation approaches. It is underscored among the key enabling conditions for implementing, accelerating, and sustaining adaptation. (Campbell, 2022). Conceptually, agricultural insurance is a contract between farmers and insurance providers where farmers agree to pay a premium in exchange of receiving a claim in case of crop failure due to a natural disaster (Yazdanpanah et al., 2013). It is the transfer of a risk of loss from one entity to another in exchange for a premium or a guaranteed and quantifiable loss. It is a form of risk management, specifically risk sharing approach used to hedge against a contingent loss. Agricultural insurance is therefore designed to provide cover for financial losses incurred due to a reduction in expected outputs from agricultural production. Specifically, agricultural insurance makes it attractive for financial institutions to extend credit to farmers to finance adaptation innovations or technologies (Carter, Cheng, & Sarris, 2016; Karlan et al., 2014; Elabed and Carte, 2014; Sookhtanlou, 2019; Jensen, 2017). It is an innovation in the climate change adaptation strategies which has been widely embraced

world over although it remains more popular in developed than developing countries, it has widely been embraced world over although it remains more popular in North America, Europe, Asia, and the USA

Agricultural insurance started in Europe over 300 years ago as a means of protection against the risk of livestock mortality and climate risk, mainly hail. Livestock insurance emerged in the 1830s. The first insurance schemes were implemented primarily by small cooperative structures that provided cover against a single identified risk. In the United States, Japan, and Canada, agricultural insurance emerged in 1939 and 1959 respectively (Thérèse et al., 2013). In African countries, agricultural insurance was adopted and remains a more effective risk management strategy among the climate change adaptation strategies (Krishna, 2017; 2019; Shaibu, Ibitoye & Ibrahim, 2019; Ibitoye & Saliu., 2019). Without agricultural insurance, conventional risk management or adaptation strategies are insufficient to address climate risk (Nnadi, 2013).

1.1.3 Agricultural insurance products

Agricultural insurance products are usually classified into three main groups: indemnity-based insurance, income insurance, and index insurance. With specific regard to index-based insurance which is most popular in Africa, the payout for index-based insurance relies on the value of an index. A threshold is set, below which the insurer will compensate the insured. Two forms of index-based insurance that is; direct and indirect indices. Direct index insurance takes form of area yield, or income insurance, for which the index is directly an area average of yield, live- stock mortality, or income. A reference yield is taken, which is the same for every farmer in the area (a village to a whole region). This type of index allows building multi-peril policies, as it covers all types of catastrophes (climatic, pests, diseases, etc.) entailing a loss of yield in the defined area. Though it is easily understood by farmers, it is costly to verify and depends on reliable historic data which may not be readily available or inaccurate. These sometimes delay the payment of indemnities.

Second is the weather-based index insurance (indirect index insurance) for which compensation is not determined by the actual loss of yield at the individual level (each farmer) but by a defined weather event that is correlated with the lifecycle of the insured

crop. The payout is triggered by changes in an index correlated to crop yields, such as rainfall, temperature, soil humidity, number of storms a year, or wind velocity. An indexed insurance contract makes the agreed payout to beneficiaries whenever the data source indicates that the index reaches the insurance activation level. The most popular weather-based index insurance promoted in Africa include; the remotely-sensed Normalized Difference Vegetation Index (NDVI) and the satellite-based rainfall index insurance (Müller et al., 2011; Müller, 2013).

Weather index insurance addresses the problems of moral hazard and adverse selection inherent in the classic indemnity-based insurance. Index insurance circumvents the complexities of loss assessments which decreases administrative costs and renders the payout process fast and inexpensive (Thérèse et al, 2013). However, they are associated with high costs of gathering and analyzing climatic data or satellite images, high cost of expertise, and high cost of studies linking the index and the lifecycles of the crops to reduce temporal and loss-specific basis risk. In addition, the cost of investing in weather stations needs to improve the index accuracy (limit spatial basis risk) by reducing its area of coverage is high.

1.1.4 Overview of Uganda's institutional framework for climate adaptation

The Government of Uganda through a public-private partnership approach has put in place an institutional framework to address the climate change problem. This is reflected in its efforts to build a robust institutional framework for addressing climate change. A summary of the institutions is mapped out in figure 1.1 and a summary of their strategic focus/provisions/role in climate change adaptation is provided in Appendix 1.1

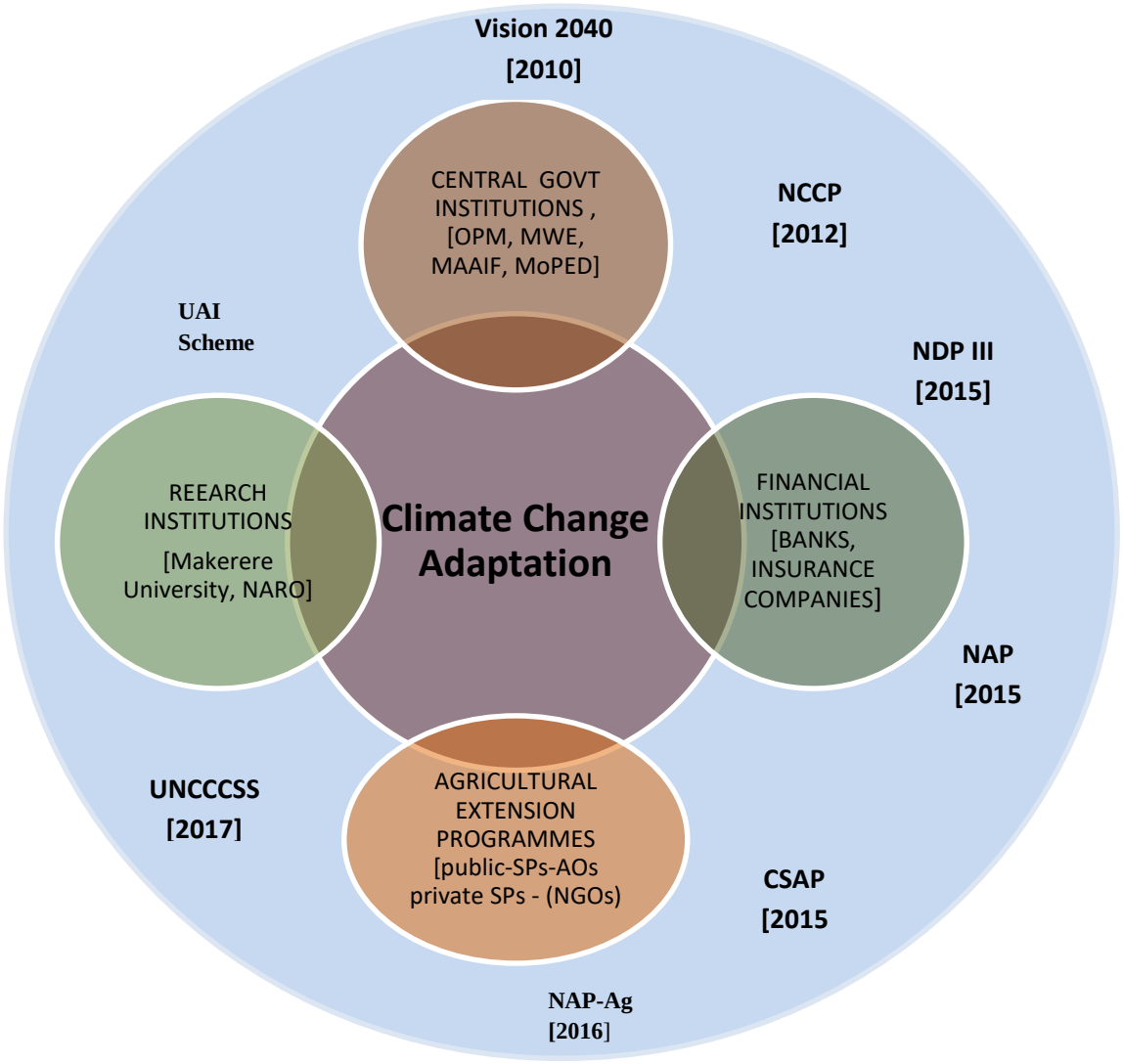


Figure 1.1: Uganda's institutional framework for climate change Adaptation

Uganda ratified the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol demonstrating commitment to the adoption and implementation of policies and measures designed to mitigate climate change and adapt to its impacts. Uganda as a member of the East African Community subscribes to the EAC climate change policy which urges Partner States to develop consistent national policies to ensure harmonized action. These international and regional commitments leverage the current national framework to address climate change problem. At the national level, addressing climate change in agriculture is mainstreamed in the country's National Development Agenda in (National Planning Authority [NPA], 2020) and the country's long-term development aspiration set out in Vision 2040 (Government of Uganda [GOU], 2010).

Institutionalization of climate change response was flagged off with development of the National Climate Change Policy (MWE, 2015) and the Nationally Determined Contributions (MWE, 2016) which were later updated in 2022 (MWE, 2022). The National Climate Change Policy was aligned with the National Land Policy (Ministry of Lands Housing and Urban Development, ([MOLHUD], 2013) which underscores the concept of sustainable land use. The land use policy was operationalized through the National Adaptation Framework for Agriculture [NAP-Ag] Framework (MAAIF, 2016) which was developed with a mandatory requirement to mainstream climate change into all subsequent sectoral budget framework papers passed (MOFPED, 2018). In addition, a 10-year Climate Smart Agriculture (CSA) Program (2015-2025), as well as the Uganda National Climate Change Communication Strategy (UNCCCS) 2017-2021, were developed between the period 2015-2016 were developed. The provisions in the policies and strategies for climate change adaptation in agriculture are mainly implemented through government institutional structures largely the Ministry of Agriculture Animal Industry and Fisheries (MAAIF), the Ministry of Water and Environment with financing support from the Ministry of Finance, Planning and Economic Development.

At national level, the climate change adaptation interventions are coordinated through the National Focal Point for Climate Change under the UNFCCC in the MWE. Further support to climate change adaptation programs draws from the National Agricultural Research Organization and universities. Management and delivery of adaptation interventions at the local level is structured through Agricultural Extension Programs at the Local Government levels that is; mainstream agricultural extension structures and Operation Wealth Creation. This array of public institutional frameworks is supported by private sector organizations categorically including; financial institutions and Civil Society Organizations which provide support in terms of financing or technical assistance in development and delivery of adaptation programs. However, it is quite paramount to critically unpack the institutional framework and analyze the climate change adaptation provisions to understand how far they mainstream agricultural insurance and determine whether they are working or not.

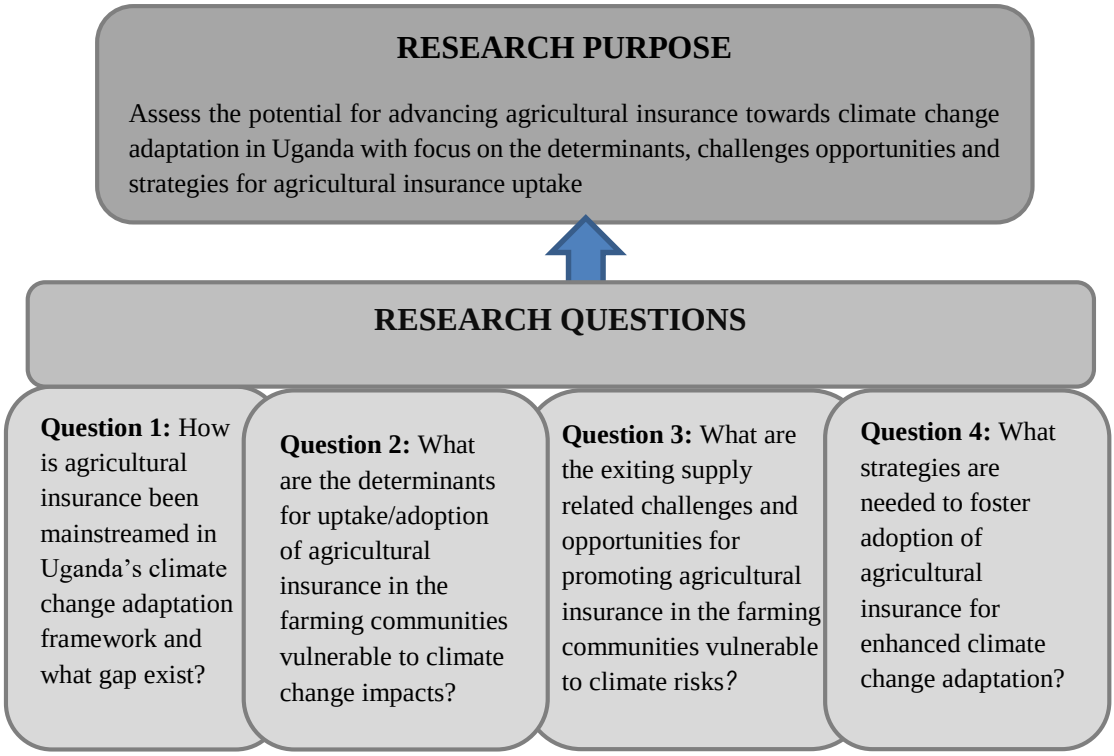
1.2 Rationale for the study

Agricultural insurance in many countries including Sub-Saharan Africa (SSA); for instance, Kenya, Ethiopia, Ghana, Zambia, Tanzania Benin, Rwanda have gained prominence in the climate change adaptation frameworks. It is underscored among the key enabling conditions for implementing, accelerating, and sustaining adaptation (Campbell, 2022; Aidoo et al., 2014; Amador-Ramirez, 2007). Consequently, there is a persistent call to mainstream agricultural insurance in the climate change adaptation framework. (Campbell 2022; Mensah et al., 2017; Miranda & Milangu, 2016; Clarke, Mukerji, & Dercon, 2014; Carter, Cheng & Alexandros 2014; Takahashi et al., 2016; Cole et al., 2013; Decorn et al., 2014). Despite its huge potential, uptake of agricultural insurance remains low in many countries (Kiguru et al., 2018; Marr, Belissa, & Lensink, 2019); Ghimire, et al., 2016; Ntukamazina, et al. Darijani, 2017; Mohammad et al. 2022; Timilsina et al., 2022); Ajiboye, et al., (2018), Sihem; 2019; Arida, Bordey & Luis, 2017). The studies have gone further to link the low adoption of agricultural insurance with a variety of factors or challenges including; quality of insurance products, basis risks, knowledge and perceptions about agricultural insurance, affordability, gender characteristics such as age, sex, income of farmers, membership to farmer groups, ownership of bank accounts, income diversity, level of climate risk exposure etc.

However, while the above-mentioned factors or challenges relate with the demand and supply of agricultural insurance and addressing them remains critical, they lack a clear and holistic conceptualization to better inform interventions to promote agricultural insurance. Besides, their applicability requires empirical testing in different climate risk and adaptation contexts. In addition, agricultural insurance systems in countries such as; Kenya, Zambia, Ethiopia present strategies that have proven effective in addressing these challenges and promoting agricultural insurance (Hazell et al., 2010; Hill and Robles, 2011; Dercon et al., 2014) which however need to be critically analyzed for contextual applicability. In Uganda, although uptake of agricultural insurance is quite relevant for climate change adaptation, its adoption remains low (Agaba, 2022; Asseldonk, et a., 2022; World Bank, 2019b) at national level with scanty empirical knowledge of the factors or challenges in account. A report by the Insurance Regulatory Authority Report (2022)

indicated that less than 1% of approximately 3.5 million farmers in Uganda have not adopted agricultural insurance. Besides, there is limited understanding on how agricultural insurance is mainstreamed or aligned in the climate change adaptation framework. Consequently, efforts to promote agricultural insurance and build adaptive capacity of farmers remain deficient of evidence-based empirical models which inversely would increase resilience in communities, improve the agro-system and ultimately realize sustainable development.

1.3 Research purpose and questions



Note: *Highlighted in the dark grey color is the purpose of the study while the light gray are the research questions which the study sought to answer*.

1.4 Overview of the study

Overall, the chapter has provided the background to the study highlighting the climate change problem and its impact on agriculture from a global perspective and in the context of Uganda. The background has underscored climate change adaptation as a response strategy to the climate change problem and identified the challenge of ineffective adaptation globally and in the Uganda context. A brief over view of the significance of agricultural insurance to climate change adaptation, the problem of low adoption of agricultural insurance and the likely determinant factors have been identified by way of problem identification and study rationalization. The chapter ends with a presentation of the research purpose and key questions which were addressed.

Building on this, the second chapter presents empirical perspectives on climate change adaptation and the significance of agricultural insurance. It critically analyzes empirical studies in the global and African context, identifying empirical perspectives underscoring the link between agricultural insurance and climate change adaptation. The section identifies the low uptake of agricultural insurance and links it with supply and demand-related factors. The third chapter presents various theoretical, empirical and conceptual perspectives on determinants for the adoption of agricultural insurance research in a variety of fields. The chapter further provides a review of the strategies which have proven effective in promoting agricultural insurance borrowing lessons from other countries.

The forth chapter presents the methodology which the study utilized to address the research questions. The chapter specifically, presents the methodology which guided the study highlighting the study site, research design, study population and sample size, sampling, data collection, and analysis methods. Leveraging on the theoretical perspectives and the conceptual model earlier presented in chapter three, this chapter derives a conceptual framework and an econometric model which guided the quantitative analysis of determinants for the adoption of agricultural insurance. The chapter ends with a presentation on the key ethical considerations in the study building on this chapter, the subsequent six chapters are structured as follows.

The fifth chapter specifically presents key episodes in the institutional framework for Uganda's climate change adaptation, analyzes how agricultural insurance is aligned with the national and agricultural sector development framework as well as the climate change adaptation framework emerges. The sixth chapter specifically presents and discusses empirical findings on the determinants of farmers' adoption of agricultural insurance deriving facts from empirical data from farmers in Bududa district. From the key lessons from the empirical analysis of the determinants for the uptake of agricultural insurance, a conceptual model is derived to guide interventions to promote agricultural insurance adoption in a climate risk context. Notably, the model provides a nexus between the demand and supply-side determinants for agricultural insurance uptake. The chapter ends with a discussion of the empirical findings.

The seventh chapter navigates through the supply-side challenges and identifies opportunities to fast-tracking the adoption of agricultural insurance. The chapter draws largely from interview engagements with key informants in the management and delivery of agricultural insurance to farmers as well as farmers' group leaders. The chapter ends with a conceptual model for understanding the supply-side constraints for the adoption of agricultural insurance.

The last chapter presents the study conclusions, recommendations, contributions, limitations and out-reach for further research. The chapter derives from the findings and knowledge generated from the study in quest to promote agricultural insurance as an effective climate change adaptation strategy. The appendices attached include; Krejcier and Morgan sample size determination table; copy of interview guide; Copy of Questionnaire for key informants, copy of introductory letter for field work, letter of authorization from the Agro-consortium, comply with consent form for key informants, copy of consent for farmers, copy of approval letter for National Council of Science and Technology and detailed SPSS outputs for correlation and regression analyses

CHAPTER TWO

EMPIRICAL PERSPECTIVES ON CLIMATE CHANGE ADAPTATION AND THE SIGNIFICANCE OF AGRICULTURAL INSURANCE

This chapter details empirical perspectives on climate change adaptation and the significance of agricultural insurance. The chapter is structured into three sections. The next section presents empirical perspectives on climate change adaptation. It highlights on studies in the global and African context. Notably, the section identifies challenges to climate change adaptation which can be addressed by agricultural insurance. The third section presents empirical perspectives underscoring the link between agricultural insurance and climate change adaptation. It specifically identifies the problem of low uptake of agricultural insurance and links it with supply and demand related factors. The chapter ends with a review of the strategies which have proven effective in promoting agricultural insurance borrowing lessons from other countries.

2.1 Climate Change adaptation strategies in agriculture

The subject of climate change adaptation in agriculture has been extensively investigated across the world. This study searched and identified a variety of empirical studies over the last decade exploring how climate change adaptation has been streamlined in agriculture in a bid to manage the adverse impacts of climate change risks in the agriculture sector. Among the studies include; Islam & Nursey-Bray (2017), Wang, et al. (2014), Okada et al. (2015), Khanal et al. (2019), Nkomwa, et al. (2014), Robinson et al. (2015), Rhodes, Jalloh, & Diouf (2014), Montanaro, et al. (2018), Khan, Gao & Abid (2020), Wang, Lee & Son (2017), Feola et al. (2015), Locatelli, et al. (2015), Chalise & Naranpanawa (2016), Mitter et al.(2018), Cui (2020), Jørgensen, Termansen & Pascual (2020), Vermeulen et al. (2018), Rippke et al. (2016), Aryal et al. (2019), Kislingerová & Špička (2022). Notably, the African context of climate change adaptation has also been investigated in many country studies for example Deji (2020), Nathanael & Hanna (2017), and Kahime et al. (2018). However, empirical evidence on climate change adaptation in agriculture in the context of Uganda remains scanty.

The above empirical studies on climate change adaptation in agriculture identify various climate risk management strategies that have been adopted in different countries as a means of farmers' adaptation to adverse impacts of climate change risks and consequently minimize farmers' vulnerability. The strategies include; adjusting farming practices and using technologies or adopting what is broadly known as climate-smart agriculture (Shrestha, 2018). Such include; a shift in the cropping calendar, the adoption of irrigation systems and drought-resistant varieties to address water scarcity, soil conservation technologies and crop intensification to address the declining soil fertility (Shrestha, 2018; Zougmore, 2021; Ssesenlo, 2020 Kath & Kanagasabapathi, 2020).

The literature on climate change adaptation further identifies barriers to adaptation (Bausch, Eakin, & Lerner, 2018; Ujah et al., 2014; Mumtaz, 2019; Topp et al., 2017; Saul, 2015; Nhan, 2016). Majority, farmers' adoptions of climate change measures remain low despite the availability of diverse climate change adaptation measures. The limited adoption of adaptation measures is attributed to challenges that largely reflect low adaptive (Gallopín, 2006). Most prominent in literature, farmers face the critical challenge of financing adaptation measures and weak institutional frameworks to promote climate change adaptation (Sunny et al., 2018; Kamau, 2013). It is believed that climate finance can support climate change adaptation by fostering investment in climate-smart agriculture, technologies, and infrastructure (Campbell, 2022). Consequently, governments are argued to build adaptive capacity. Among the strategies widely recommended include; developing institutional frameworks which effectively support climate change adaptation (Tigist, 2017; ADB, 2017; Williams, Crespo & Abu,2019); promoting financing of agricultural financing through the institutionalization of agricultural insurance in climate change adaptation programming (Miranda & Milangu, 2016;) and creating awareness about climate change adaptation innovations.

2.2 Agricultural insurance and climate change adaptation

Agricultural insurance remains one of the most prominent innovations widely promoted as a strategy to manage climate risks in agriculture owing to its potential to promote climate financing. Specifically, agricultural insurance makes it attractive for financial institutions to extend credit to farmers to finance adaptation innovations or technologies (Carte, 2014

Carter, Cheng, & Sarris, 2016; Karlan et al. 2014; Elabed and Carte, 2014; Nnadi, 2013; Thérèse et al., 2013; Sookhtanlou, 2019; Jensen, 2017). It has been widely embraced world over although it remains more popular in the developed than in the developing countries, it has widely been embraced world over although it remains more popular in high-income countries particularly, in North America, Europe, Asia, and the USA. In terms of premium value by each country, USA, China. Canada, Mexico, and Spain dominate the global agricultural insurance market (ADB,2017).

In many other developing countries and particularly in Sub-Saharan Africa, Agricultural insurance is making breakthroughs even if it is still at an experimental stage in many cases (Thérèse et al, 2013; Ntukamazina, et al., 2017). In Africa, many countries are actively participating in index-based insurance although the agricultural insurance market is least developed compared to other continents (Ntukamazina, et al., 2017). A study on the Landscape of Micro-insurance in Africa conducted in 2011 paints picture of the agricultural insurance market in Africa. The study reports that 220,000 households were covered by agricultural micro-insurance in Africa by 2011. Agricultural insurance is more popular in countries including; Algeria, Angola, Benin, Botswana, Burkina Faso, Djibouti, Egypt, Ethiopia, Ghana, Kenya, Malawi, Mali, Mauritius, Morocco, Mozambique, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Tunisia, Zambia and Zimbabwe (Ntukamazina, et al., 2017)

Owing to its significance to climate change adaptation, the subject of agricultural insurance has attracted empirical investigations over the last decade. A scan through the literature on agricultural insurance revealed a variety of empirical studies (Long et al., 2014; Akinola, 2014; Carter, Cheng, & Sarris, 2014; Muneepeerakul, 2015; Carter, Cheng, & Sarris, 2016; Hellin, 2016; Ghimire, et al., 2016; Darijani, 2017; Zhang & Chen, 2019; Tang & Luo, 2021; Olajide-Adedamola et l. 2019; Diagne & Saito, 2019; Trestini, et al., 2020). In Africa, agricultural insurance has equally been extensively investigated mainly in Nigeria (Adeyonu, 2016; Salau, & Jacho, 2018; Olajide-Adedamola et al., 2019); Zimbabwe (Monday et al., 2020;); Ethiopia (Marr, Belissa, & Lensink, 2019); Ghana (Adjabui, 2018).

[1] M.J. McCord, R. Steinmann, and M. Ingram, "Briefing Note: The Landscape of Micro insurance in Africa 2012," (Bonn: GIZ; Munich: Munich Re Foundation, 2012).

Despite the extensive research on agricultural insurance, a few studies (Jay, 2015; Njegomir et al., 2016; Ndagijimana et al., 2017; Ineci, 2018; Gbigbi & Ikechukwuka, 2020; Ntukamazina, et al., 2017; Mustapha, Kaechele & Bavorova, 2023). Notably, these studies observe that the uptake of agricultural insurance remains low.

Forexample a more recent study by Mustapha, Kaechele & Bavorova (2023). analyzed the drivers of awareness and adoption of agricultural insurance in Nigeria to better understand the adoption process. across six agro-ecological zones in Nigeria, covering areas with different socioeconomic characteristics of farmers and levels of climate risk. The study findings indicated that more than half of the farmers were unaware of agricultural. insurance. Logit regression results underscored the significance of socio-economic characteristics specifically: education, access to a bank and access to information to adoption of agricultural insurance. Low awareness, lack of knowledge about the effectiveness of insurance, difficulty and affordability of insurance, farmers' low level of trust in insurance providers, late payment of claims and inadequate compensation were among the main barriers to adoption of agricultural insurance.

We find it more appropriate not to delve into the empirical perspectives on the low uptake of agricultural insurance here but rather refer to the next chapter where the empirical perspectives are presented alongside the theoretical and conceptual perspectives with a view of identifying the variables and framing paving way for the analytical framework of the study.

It is however observed that many classic insurance products are difficult to implement or not viable at all in developing countries, mainly due to "the nature of disaster risks, lack of data, restrictive regulations, small scale of operations, and potential for moral hazard" (UNFCCC, 2008). While agricultural insurance could be a viable formal risk transfer mechanism, other informal coping strategies such as relying on international financial aid or kinship ties, tax reliefs or financial grants in areas prone to extreme weather events, can be an option at individuals, community or national level (IPCC, 2012). For example, Sovereign insurance is recommended in low-income countries since they are less likely to raise sufficient and timely capital to replace or repair damaged assets and restore livelihoods following major disasters" (IPCC, 2012) Sovereign insurance is defined as a risk financing

strategy for governments and may include reserve funds or contingent debt (Ghesquiere, 2007). This form of risk sharing saves national governments from uncertainties related with relying on donor support hence minimizing their insecurities concerning the size, time, and frequency of the payouts. However, it puts farmers at the mercy of government if not directly covered under micro-level or meso-level insurance. Nevertheless, agricultural insurance remains a popular climate change adaptation strategy and various strategies have been proposed on hose best its adoption can be promoted as discussed in the following sub-section

2.3 Strategies to promote uptake of agricultural insurance

Given the demand and supply side constraints presented in the previous section, the subsequent section identifies the strategies which have proven effective in promoting agricultural insurance by addressing the barriers on the demand and supply sides. Addressing the constraints on the demand and supply of agricultural insurance is critical to promoting agricultural insurance, particularly in the context of small holder farming communities affected by climate change. The empirical studies draw lessons from agricultural insurance systems in countries such as; Kenya, Nigeria, Zambia, and Ethiopia which open insight insights into the strategies that effectively promote agricultural insurance (Hazell et al., 2010; Hill and Robles, 2011; Dercon et al., 2014). This section, therefore, delves into the strategies identified to promote uptake of agricultural insurance

Literature on mainstreaming agricultural insurance in climate change adaptation underscore the need for effective institutionalization of agricultural insurance in climate change adaptation programming. The government is believed to play a key role in positioning index insurance programs within the existing regulatory framework, particularly the insurance and financial regulations, agricultural sector programming, and climate change adaptation. A robust regulatory framework for mainstreaming agricultural insurance in climate change adaptation comprises of structures, policies, strategies, and programs (Carter, 2013. The regulatory environment should provide an environment to enforce contracts that both buyers and sellers can trust. Government should provide certification standards for contract quality, most importantly via an accepted measure of basis risk. Government is mandated

to institutionalize standards that new index insurance contracts should meet. Penalties should be institutionalized which can lead to penalty pricing when probability estimates for risk have high variance because of what Carter (2013) calls the "sparse data problem". Structures and programs are critical to govern and support interventions to scale up agricultural insurance in climate change adaptation. Government can also ensure that insurers effectively target and deliver a mutually beneficial insurance service to small-holder farmers (Miranda & Milangu, 2016).

Capacity building for development of insurance products

A substantive argument has been raised rationalizing the significance of capacity building in the development of agricultural insurance. Miranda & Milangu (2016) observe that **a**griculture insurance is a complex concept that requires technical capacity and substantial investment in capacity building for effective institutionalization and delivery, particularly to the remote, poor farmers but yet more prone to agricultural production risk in the face of climate change. Besides, the biological processes of production are complex necessitating skills and expertise. In addition, substantial adoption rates by smallholders require that insurance products are technically well-designed to fit farmers' needs and match their economic capacities. Insurance contracts and pay-out modalities should be clear, transparent, and easy to understand. The insurance package needs to be locally relevant and designed in an incentive-compatible manner (Marr et al., 2016; Wairimu et al., 2016*)*. In the USA for example, 22 different types of programs (including area yield and revenue programs, rainfall and vegetation index-based products, and multiple peril revenue and yield products) covering over 130 different crops have been offered and high agricultural insurance participation recorded 80% uptake by farmers in areas eligible for insurance. In recognition of the specialized nature of agricultural insurance, insurance companies operating in the market either have dedicated agribusiness units or outsource the underwriting to agencies that specialize in it (Nnadi, 2013).

Experience from better performing agricultural insurance systems in countries such as Kenya and Ethiopia suggest that sensitization and training of stakeholders is critical for institutionalization and promoting agricultural insurance (Dercon et al. 2014). World Bank

(2019b) consistently observes that public and private sector stakeholders need to overcome institutional, technical, and financial challenges. In countries such as Kenya, Tanzania, and Rwanda that have made significant steps in promoting agricultural insurance, a wide range of partners have been involved with sufficient capacity (Greatrex et al., 2015). Experience with the Climate Change and Insurance Program in Kenya indicates that the capacity to take up weather-index insurance products is quite challenging (Knoke, 2014).

Stakeholders' participation and coordination

Participation and coordination of stakeholders in promoting agriculture is quite paramount to building trust, buy-in, and sustainable capacity for the supply of agricultural insurance. In Kenya for example, several companies are engaged in extending index-based weather and area yield insurance products for various crops and livestock in different parts of the country (Joab et al. n.d). Overall, one of the key issues is the need to determine which roles can be effectively taken over by the private sector and which support governments have to provide to allow the development of a thriving index-based agricultural insurance service for resource-poor smallholder farmers (Joab et al. n.d) achieve robust or integrated insurance programs as was the case for the Climate Change and Insurance in Kenya. For example, some stakeholders will be promoting conventional adaption measures alongside agricultural insurance, an economic aspect of the risk transfer, which incorporated weather derivatives such as indexed (weather, yield) insurance. In addition, the salvage tactic was employed to rescue those that were unable to adapt by providing safety nets. In addition, the project's CRM strategy aimed to maximize opportunities – such as promoting efficiency, productivity, and sustainability (Knoke, 2014). A bottom-up approach to stakeholder participation is paramount. For example, the GIZ/ACCI risk management and weather-indexed insurance initiative involved a bottom-up approach, starting with desk studies (literature review of indexed insurance initiatives worldwide, including Kenya), scientific studies, participatory perception, assessments and extensive consultation to identify entry points

An integrated approach for promoting agricultural insurance

The need for an integrated approach is critical to building synergies for the success of agricultural insurance programs. Taking the case of Kenya, after the failure of initial agricultural insurance programs, the government initiated a program "Adaptation to Climate Change and Insurance" (ACCI) for climate risk management. This program funded by the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (Knoke, 2014) registered commendable successes in promoting agricultural insurance and managing climate risk. The initiative was a flexible strategy based on responding to needs and lessons learnt; and guided by the outcomes of stakeholder consultation forums. The insurance program design employed an integrated approach combining prevention of disaster from occurring, avoiding the risk from the disaster, or providing measures to reduce the impact of the risks from the disaster. Such an integrated approach enhances the effectiveness of agricultural insurance.

The ICCA leveraged the notion that if the risk can't be avoided then options to prevent the risk from causing disaster must be looked for, and if the disaster can't be prevented from occurring then options that reduce the impact of the disaster must be provided. The integrated approach can also be considered to combine protective strategies (agricultural insurance), preventive conventional adaptation measures (soil conservation, water conservation practices, minimum tillage, drought-resistant varieties/species, etc.) and avoidance measures (early warning signs). Other supporting programs to the ICCA. included, resource mobilization and capacity building and regular tracking of quality data, and sharing mechanisms with the stakeholders: This requires staff commitment and tools such as training manuals on agricultural insurance that are tailored to targeted TOTs and farmers. Above all, agriculture insurance ACCI thrived under a framework of supportive national organizational-level policies (Knoke, 2014).

Design of indices with minimal basis risk

Improvements in product design allow the reduction of the impact of each component of basis risk. Basis risk faced by the farmer when the value of the indemnity payments falls below the actual magnitude of the insured loss suffered by the farmer (Carter, 2011). The

closer the correlation between the index and the yield, the less likely basis risk is. The literature identifies a variety of strategies for minimizing basis risks or improving the quality of indices (Carter, 2011). Basis risk can be reduced through contractual, technological and institutional innovations (Carter, et al., 2014). Lessons from Mali show that contracts with double scale/trigger can focus on real losses whilst still avoiding moral hazards (Carter, 2011). A primary trigger at a smaller scale (village) allows a close correlation with individual losses. To avoid moral hazards associated with the trigger, payment of indemnities can be tagged to a second trigger on a larger scale (several villages, a cooperative). In addition, the development of a mutual insurance pool at the community level would play a traditional role in assessing individual loss rates by the community. Lastly, the community can subscribe to an index insurance policy for correlated risks. The index acts like a reinsurance contract in this case (Carter, et al., 2014). In the context of Uganda, the issue of basis risks, how it affects insurance uptake, and how it is minimized was an area for empirical investigation in this study.

Technological innovations such as: satellite images, remote sensing, telecommunications, have proven effective in collecting quality data for the construction of more accurate indices. Technological measures such as the use of satellite sensors with a resolution as small as 3m x 3m have proven reliable predictors of biomass growth (e.g., evapotranspiration measures). Drone aircrafts are another possible inexpensive source of high-resolution information for predicting crop yields. Experience from the WFP/IFAD in Senegal and New I4 work projects in Tanzania suggest that biomass-based measures perform better (Carter, 2018). Lessons from Kenya and Rwanda (International Growth Centre, 2016; Tadesse et al., 2015), as well as Ethiopia (Mugambi, 2015), also identify the use of telecommunication mobile network as a more effective marketing and delivery channel for agricultural insurance. There are also lots of recent innovations in developing indices with minimal basic risks based on remotely sensed data in countries such as Ethiopia, Kenya and Zambia among others. However, investment in such innovative approaches is constrained by limited incentive, interest, and ability among the private agricultural insurance providers (FSD, Kenya 2013).

Contractual innovations argue for secondary, backup or audit indices. In rare cases when insured farmers claim that the primary index failed, then the secondary or backup audit index is implemented. The idea of audit indices draws credence from the IFPRI/I4 project in Ethiopia. Another experience can be drawn from West African cotton producers. As described by Elabed et al. (2013), the primary index is set at a level that is too low from a moral hazard perspective (village yields). However, low yields at the village level only release payments subject to a secondary audit. Specifically, payments are only made if yields at a broader geographical scale (surrounding villages) are consistent with low yields in the initial village being the result of natural causes as opposed to morally hazardous behavior. In Burkinafaso, the innovation of audit indices proved effective in increasing insurance uptake to nearly 30% area insured to approximately 30,000 hectares. Arguably, lessons learnt on the above innovations for addressing basis risk were among areas in which key informants were probed in terms of their applicability to the context of Uganda's insurance system. Key findings to this effect, are presented in chapter seven under supply-side challenges to the uptake of agricultural insurance.

Adoption of Meso-level insurance

Meso-insurance has proven effective in promoting the uptake of agricultural insurance by individual group members (Decorn, Clark & Hill, 2011). This approach to insurance provides group cover to an aggregator, such as a financial service provider, farmers' association or input supplier. In turn, the aggregator retails its benefits to farmers through a variety of services. Basis risk is reduced as policies cover a larger portfolio through a single index written at the aggregate level. Claims may be distributed conditionally to the effective loss of each group member (Decorn, Clark & Hill, 2011). Distribution is also expected to be easier and more cost-effective, as the training process only has to reach aggregators. Another advantage is that once convinced, the aggregator will, in turn, advocate for the product which can raise the trust of insurance products amongst the other group members. From the organizational point of view, the aggregator is in charge of collecting premiums and redistributing claims, which saves administrative costs compared to the individual insurance scheme. Because the sold policies to farmers in groups, significant sales volumes are quicker to achieve (Décorn et al. 2011)

The potential of meso-level insurance lies in the fact that it takes away the agricultural risk from the balance sheet of lenders by transferring it to the insurer. In this way, meso-level agricultural insurance could allow lenders to increase their exposure to the agricultural sector without being too exposed to large agricultural shocks. In turn, this could support farmer investments (fertilizer, improved seeds, machinery, and the like) in agricultural productivity. Individual farmers may benefit from such arrangements directly, for example, if they get insurance attached to an agricultural loan or other agricultural input product. It may also reduce insurance premiums. Indirect benefits are, however, equally valuable, as they could allow lenders to increase their agricultural portfolio without being too exposed to large agricultural shocks. In turn, this could support farmer investments in agricultural productivity, such as fertilizer or improved seeds. A meso-level insurance product will most likely be mandatory (bundled) for the farmers who will bear the extra cost of the product. Clear information will ensure that the farmers understand the benefits they are entitled to. Since aggregators are the primary insured party, the farmers' value offered by meso-level insurance is questioned. Another major concern regarding farmers' value is the interactions within the group.

Other strategies which have proven effective in promoting agricultural insurance include; risk layering to minimize the cost of insurance and make it more affordable and; promoting indices as a public good to build farmers' trust in the indices and enhance outreach to farmers. The approach of risk layering leverages the notion that; climate risk management should go beyond index insurance and take a portfolio approach combining different instruments on a demand-driven basis. In other words, the delivery of index insurance products should be coordinated with the provision of other financial services and resilience-building investments This will allow customization of the various instruments effective for this purpose, including insurance, savings, credit, technology and infrastructure, where insurance serves as a complement to other instruments (Carter, et al., 2014). The need for promoting agricultural insurance as a public good was also underscored by Carter, et al. (2014) at the 8th International Micro-Insurance Conference held in Dar es salaam, Tanzania, in November 2012.

2.4 Summary

In a nutshell, this chapter has evidenced that the subject of climate change adaptation in agriculture has been extensively investigated across the world. A variety of climate risk management strategies have been adopted in different countries as a means of farmers' adaptation to climate risks and consequently minimize farmers' vulnerability and foster their resilience. Notably, there is strong evidence that adoptions of climate change measures remain low and this remains an issue of concern in the climate change adaptation literature. The low adoption of conventional adaptation strategies has largely been linked to farmers' limited access to finance. It deprives farmers of adaptive capacity and agricultural insurance can potentially enhance farmer access to credit finance by rendering them insurable. However, its uptake remains low. The chapter ends with a presentation of the strategies which have proven effective in promoting agricultural insurance. They include; institutionalization of agricultural insurance in the climate change adaptation agenda; capacity building for the development and delivery of appropriate index insurance products; stakeholders' participation, coordination and collaboration to build trust, buy-in, and sustainable capacity for supply and demand of agricultural insurance; using an integrated approach for promoting agricultural insurance; improving design of indices through technological and contractual innovations; adoption of meso-level insurance to minimize transaction costs; and promoting indices as a public good for greater out-rich**.** Nevertheless, where agricultural insurance is not adoptable, alternative informal coping strategies such as relying on international financial aid or kinship ties as well as tax reliefs or financial grants and sovereign insurance in areas prone to extreme weather events can be an option at individuals, community or national level.

CHAPTER THREE

THEORETICAL AND EMPIRICAL PERSPECTIVES ON FARMERS' ADOPTION OF AGRICULTURAL INSURANCE

The increasing uptake of agricultural insurance remains a fundamental issue in the literature on agricultural insurance. This chapter presents theoretical and empirical perspectives on the determinants for the adoption of agricultural insurance. The empirical perspectives inform the conceptual framing of the drivers and constraints for agricultural insurance uptake presented in the third section of the chapter. Notably, the conceptual framework identifies variables that were considered in the analytical framework for the determinants of insurance uptake in the context of this study.

3.1 Theoretical perspectives on adoption

The empirical analysis of the determinants for uptake of agricultural insurance from a demand-side perspective borrows insights from consumer behavioral theories which have emerged over the years to try and demonstrate the determining factors of consumers' approval of novel technologies and their intention to use technology. These include; the Theory of Reasoned Action-TRA (Fishbein & Ajzen, 1975), the Technology Acceptance Model-TAM (Davies, 1989), the Theory of Planned Behavior-TPB (Ajzen, 1985; 1991) the 'unified theory of acceptance and use of technology (Venkatesh & Speier, 2013), the Theory of Diffusion of Innovation (Rogers, 1995) a well as the utility maximization theory. These theories provide useful theoretical insights that guided the analysis of the adoption or uptake of agricultural insurance and its determinants. The theories also offer valuable insights into the analysis of the constraints to uptake as well as the opportunities and measures which can be undertaken to foster uptake and effectively advance agricultural insurance as a climate change adaptation strategy. Notably, the econometric analysis of determinants for adoption or the choice to adopt or not mainly leveraged on the utility maximization theory also known as the rational choice model. A summary of the theoretical perspectives is provided in figure 3.1 below

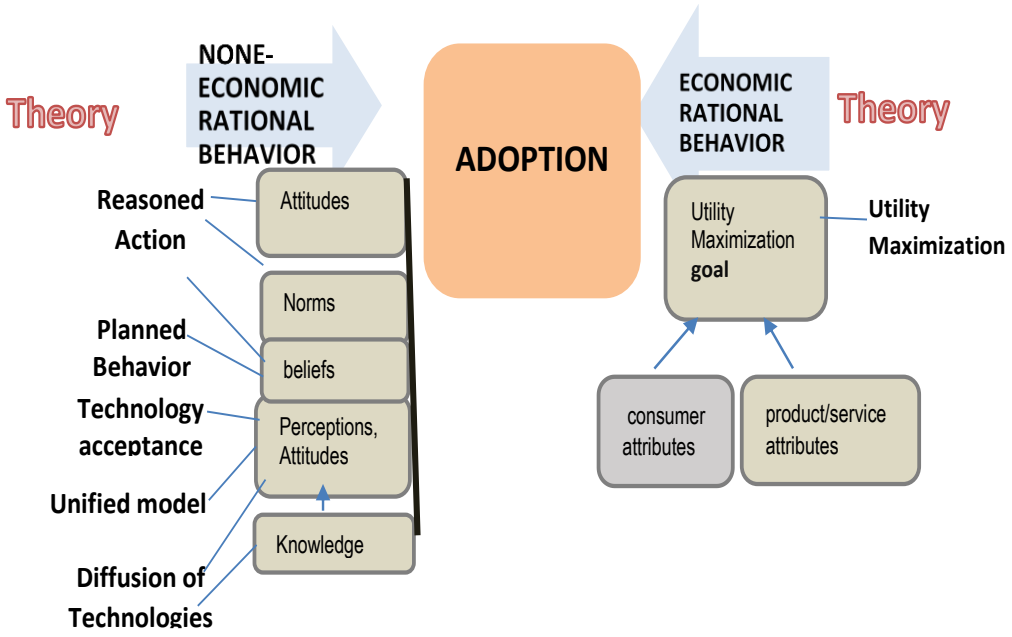


Figure 3.1: Summary of the theoretical perspectives on adoption

As indicated in figure 3.1, the study used behavioral theories to analyze the determinants for adoption of agricultural insurance which were categorically conceptualized in two dimension that is; the social irrational behavioral theories and the economic rational behavioral theory. The former generally assumes that consumers make irrational decisions based on their beliefs, norms, perceptions and (or) attitudes. Notably, norms, attitudes and perceptions are related. Perceptions and attitudes are shaped by cultural norms or knowledge and experience gained through exposure to the technology or innovations. The other dimension of economic rational behavior assumes that consumers can make rational economic choices and therefore opt to adopt a technology or innovation depending on the extent to which it maximizes their utility or satisfaction.

Notably, the utility is likely to be influenced by the characteristics of the consumer or potential adopter and the attributes of the technology or innovation The above behavioral theories were chosen since they have proven effective in explaining adoption of agricultural technologies or innovations and agricultural insurance specifically in previous studies such as Kiguru et al., (2018), Marr, Belissa, & Lensink in Ethiopia (2019); Ghimire, et al.,

(2016); Ntukamazina, et al. Tabaeian, & Ajili (2010), Darijani (2017); Mohammad et al. (2022), Timilsina et al. (2022); Ajiboye, et. (2018), Sihem, (2019), Arida, Bordey & Luis (2017), Asseldonk, et al. (2022) & Agaba, (2022). They therefore guided the study on the factors which affect adoption of agricultural insurance as a climate change adaptation innovation. In the context of the farming communities. Further justification for choosing these behavioral theories leverages on the notion that agricultural insurance is an innovation which farmers have a choice to make regarding whether to adopt or not. Besides, they have varying socio-economic characteristics and the insurance facility offers products which may bear varying levels of economic significance to farmers depending on nature of their farming operations. In addition, the insurance products bear a cost implication and economic significance to the farming business that farmers would have a rational choice to make basing on the utility of the insurance products. These factors were deemed likely to play in to affect adoption of agricultural insurance. A critical analysis of these theories with a focus on their assumptions and contextual relevance to the study is presented in the sub sequent sub-sections.

3.1.1 The Theory of Reasoned Action

The Theory of Reasoned Action was advanced by the psychologists Martin Fishbein and Icek Ajzen (Fishbein & Ajzen, 1975). The theory guides the prediction of an individual's intention to engage in a behavior at a specific time and place. The theory explains behaviors over which people can exert self-control. It treats the behavioral intentions of individuals as a function of their beliefs, attitudes and subjective norms which influence behavioral intentions. Beliefs concerns one’s thinking that an action taken will yield a certain outcome while attitudes concerns the thinking that an outcome is favorable or unfavorable. Intentions concern the way someone intends to behave in response to their beliefs and attitudes. The theory therefore argues that; individuals’ beliefs and attitudes shape their intentions and subsequent behavior to either take up or not take up an action. Subjective norms concern the thinking, preference, or interests of all other important people in someone's life associated with one’s action behavior.

In the context of the adoption of agricultural insurance, the theory of planned behavior opened insights into the theoretical assumption that, farmers' intentions and subsequent behavior to adopt or not adopt agricultural insurance depends to some extent on their beliefs and attitudes about the insurance facility. Farmers' adoption of agricultural insurance depends on the extent to which they believe that the benefits associated with the insurance facility can be realized and would make economic sense to them. The drawback of this theory is that it does not provide insights into the factors which can influence individuals' beliefs and attitudes. In the context of the adoption of agricultural insurance and while farmers' beliefs and attitudes towards agricultural insurance are necessary, it is equally important to understand the underlying factors to the beliefs and attitudes to effectively design interventions to promote agricultural insurance uptake. The other limitation is a significant risk of confounding between attitudes and norms since attitudes can reflect or shape the wider society's norms. In addition, one's freedom to act or behave can be influenced by environmental or organizational factors and unconscious habits.

3.1.2 The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) by Venkatesh & Speier (1999). attempts to resolve the above limitations associated with the TRA and is essentially a more current version of it (LaCaille, 2020). The TPB assumes that one's behavior is a function of control beliefs that concerns one's thinking that certain factors also known as control factors will be an obstacle to their behavior or realization of outcomes from the behavioral actions depending on the control power of the factors (Rossi & Armstrong, 1999). Categorically, the factors could be personal (traits, locus of control and emotions), socio-economic (age, gender, race, ethnicity, education, income and religion), and environmental. This theory opens insights that besides the belief in realizing an intended outcome and their attitudes around the outcome individuals may have regarding a certain action, their behavior regarding whether to adopt or not may further depend on their thinking of the obstacles or control factors to their behavior or realization of the intended outcomes from their behavioral decision. In other words, individuals may not take on a behavioral action such as adoption in the face of their belief in the existence of some obstacles which could hinder their action. In the context of the current study, the TPB theory lends the thinking that the adoption of

agricultural insurance may depend on farmers' beliefs in the existing factors which could constrain adoption or realization of potential benefits from adoption. The factors could be personal, demographic, or environmental. The TPB theory, therefore, lent this study a theoretical proposition that farmers may be reluctant to adopt agricultural insurance based on their belief that there are existing constraints related to their personal and socio-economic characteristics which will undermine their capacity to adopt agricultural insurance even if they choose to adopt.

3.1.3 The technology acceptance model

The Technology acceptance model (TAM) is one of the popular models, which helps to relate how peoples come to admit and utilize new technologies. The model focuses on factors determining behavioral intention to use new technologies from the end user's perspective (Becker, 2016; Wu, 2014; Tarhini, 2014). TAM comprises core variables of user motivation: perceived ease of use, perceived usefulness, and attitudes toward technology. The TAM has been extensively applied (Faber, Geenhuizen & Reuver, 2017; Kuyo, Muiruri & Njuguna, 2018; Lia, 2017; Al-Emran, Mezhuyev & Kamaludin, 2018) in the analysis of technology uptake in diverse fields including health, education, agriculture among others. This theory rationalizes the focus on analysis of the effect of farmers' characteristics on uptake of agricultural insurance particularly their knowledge, perceptions and attitudes towards agricultural insurance

3.1.4 The unified theory of acceptance and use of technology

Venkatesh et al. (2003) compared the conceptual and empirical similarities of eight models of technology adoption and developed a model that combines the most common variables of all eight models (Diep, Cocquyt, Zhu, & Vanwing, 2016). The new model is referred to as a 'unified theory of acceptance and use of technology which provides a greater understanding of the acceptance of a technology. The new model goes further to assume that attitudes, perceptions, and norms are influenced by factors including; gender, culture, technology awareness, and experience. While these theories underpin the influence of behavior, they appear unrealistic with the assumption that consumers are irrational and driven by norms, attitudes, and perceptions. They ignore the fact that consumers can take

rational decisions or behave rationally. Their attitudes and perceptions can be based on rational observations and goals. This argument paves way for the utility maximization theory which mainly positions to underpin the rational behavior of consumers

3.1.5 Rogers' theory of diffusion of innovations

Rogers' theory of technology adoption has been applied in a variety of disciplines including economics over time as one of the most popular adoption models (Wilson et al., 2002). In view of Rogers (2003), The word "technology" and "innovation" are synonymous Adoption is defined as a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation". Diffusion is defined as the process in which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003). This theory looks at adoption from the perspective of the process as well as the factors. It primarily underscores the significance of awareness and knowledge among potential adopters as well as time to enhance the adoption of technologies. Regarding the adoption process, Rogers' theory identifies the innovation-decision process with five sequential steps including; knowledge, persuasion, decision, implementation, and confirmation. Knowledge has the potential to motivate an individual to learn more about the technology and eventually adopt it. The decision stage in the innovation-decision process, the individual chooses to adopt or reject the innovation. The implementation stage of an innovation is put into practice which is also affected by uncertainty. The innovation needs interventions to foster the adoption process. Rogers' theory also provides insights that sustaining adoption necessitates a positive attitude sort of which leads to discontinuance.

Rogers's theory further argues that adoption is likely to depend on perceptions of and the attributes of an innovation or technology. The perceptions concern the degree to which an innovation is perceived as being better than the idea it supersedes. They depend primarily on the potential adopters' awareness and knowledge about the innovation or technology. The attribute of the technology concerns is complexity which means the extent to which an innovation is perceived as relatively difficult to understand and use. Complexity is

negatively correlated with adoption. In addition, compatibility of the technology is another important attribute that has to do with how the technology matches the individuals' needs and capabilities.

In the context of this study, Rogers' theoretical assumptions regarding adoption provided theoretical propositions that farmers would adopt agricultural insurance based on their perceptions about this innovation against mitigation of climate risks. The perceptions typically entail its relevance in the context of climate and other production risks as well as potential benefits in terms of the economic value of the insurance. The perceptions and ultimate decision to adopt agriculture ideally depends on how much farmers know about agricultural insurance. In addition, drawing from Rogers' theory, agricultural insurance can be considered a complex innovation that is difficult to understand and appreciate. Above, Rogers' theory opens insight into the significance of farmer support mechanisms towards enhanced adoption of agricultural insurance. The theory further opens insight into the view that farmers may or not take up agricultural insurance depending on a variety of factors that could be inherent in the design of the insurance products, the way it is communicated as a matter of marketing, the support mechanisms, attributes of the farmer including; their knowledge and their attitudes. In addition, the attributes of the technology including; its compatibility with the nature of farming systems and it economic value in the perspective of the farmers may affect adoption. At the system level, the structures involved in promoting agricultural insurance, their capacities, and challenges are critical.

3.1.6 The utility maximization theory

The utility maximization theory dates back to the 19th century with the works of Betham (1970). The concept of utility maximization was developed by the utilitarian philosophers Jeremy Bentham and John Stuart Mill. It was incorporated into economics by English economist Alfred Marshall. It assumes that; individuals or organizations seek to attain the highest level of satisfaction from their economic decisions; consumers have a budget constraint, and therefore makes rational decisions and choose among the alternative which maximizes their satisfaction. They continue investing in the option taken to a magnitude until the marginal utility is zero. In economics, utility is linked with satisfaction and

willingness to pay both in terms of choice to pay, the magnitude to pay for and price a consumer would be willing to pay for a good or service. The assumption is that the choice to pay, the magnitude to pay for as well as the price paid depends on the consumers' derived satisfaction or utility. Notably, utility from an economic point of view depends on many factors.

In the context of this study, the utility maximization theory makes sense and was adopted as the main theory to guide the econometric analysis of determinants of farmers' uptake of agricultural insurance based on three facts. Farmers have a choice to make between buying agricultural insurance or not. Secondly, insurance has embedded economic utility to a farmer since it mitigates economic losses from farmers' investments. On other hand, the insurance attracts credit to farmers for investment in production and productivity-enhancing technologies with the potential for increasing economic gains for the farmer. Thirdly, farmers can choose the magnitude of insurance cover based on the marginal utility and total utility they derive from the additional and total hectares of the land insured. Hence, the study derived the analysis of farmers' adoption of agricultural insurance leveraging on the derived assumption that farmers will choose to adopt agricultural insurance depending on the economic utility derived from buying the insurance cover. Specifically, the utility maximization function for farmers' choice to adopt agricultural insurance was fitted. Its however noted that utility is a function of so many factors which cannot be estimated in a single regression model. Hence, the study conceptualized the factors into farmer and farm characteristics and consequently applied chi-square and correlation tests to determine the specific factors which were fitted in the regression model based on their significance to adoption and the emerging intra-correlations.

The conceptualization of farmer characteristics drew insight from the none-economic behavioral theories based on the argument that farmers' attitude and perceptions and knowledge which are underscored by these theories are typically farmer characteristics which affect the perceived utility maximization of the farmers. Hence the none-economic behavior theories of utility maximization were able to support the analysis of the determinants for adoption of agricultural insurance from the perspective of lending insights

to the theory regarding other farmer characteristics (knowledge, perceptions, attitudes) which can potentially affect adoption of agricultural insurance

3.2 Empirical perceives on determinants for agriculture insurance uptake

Many of the studies on agricultural insurance in the context of Africa such as Tsikirayi, Makoni, & Matiza (2013) and Topoya, (2016), Kiguru et al., (2018), Marr, Belissa, & Lensink in Ethiopia (2019); Ghimire, et al., (2016); Ntukamazina, et al. Tabaeian, & Ajili (2010), Darijani (2017); Mohammad et al. (2022), Timilsina et al. (2022); Ajiboye, et. (2018), Sihem, (2019), Arida, Bordey & Luis (2017), Asseldonk, et al. (2022) & Agaba, (2022) identify low adoption of agricultural insurance and few of them go further to identify the challenges in account. The constraints undermine the effectiveness of efforts to promote agricultural insurance as a climate change adaptation strategy. Many of the above studies link the low uptake of agricultural insurance largely with demand and supply side-related factors. The demand-related challenges include; limited willingness to pay for agricultural insurance due to perceptions of "basis risks" which render the indices unattractive, limited knowledge and understanding of agricultural insurance, low affordability, risks averseness, lack of trust with the underwriters, high transaction costs and basis risks (Cole et al., 2013; De Bock and Gelade, 2012; Hill et al., 2014 Hazell et al., 2010; Greatrex, et al., 2015; Carter et al., 2014; Binswanger-Mkhize, 2012; Clarke et al. 2012; Cole et al., 2012; Norton et al., 2014; Takahashi et al., 2016; Mensah et al., 2017; Agaba, 2022; Asseldonk, et al, 2022). Supply-side constraints include; weak institutionalization of insurance, ineffective distribution mechanisms, and high transaction costs which render agricultural insurance inaccessible to farmers (Clarke, Mukerji, & Dercon, 2014; Hazell et al., 2010; Carter, Cheng & Alexandros 2014; Binswanger-Mkhize, 2012; Cole et al., 2013; De Bock and Gelade, 2012; Decorn et al., 2014). These challenges limit farmers' access to agricultural insurance which would foster their access to agricultural finance thereby building their adaptive capacity (Williams, Crespo & Abu, 2019).

It is therefore implied that effective institutionalization of agricultural insurance in climate change adaptation programming and addressing the demand and supply side constraints to the uptake of agricultural insurance are critical for promoting the uptake of agricultural insurance and building adaptive capacity for effective climate change adaptation. For better

conceptualization and ease of understanding for integration in this study, we provide a critical analysis of the demand and supply side constraints and derive a broader and clearer conceptualization of the constraints summarized in a conceptual model presented in the subsequent chapter.

3.2.1 Farmer characteristics

Farmer characteristics linked with agricultural insurance uptake in many empirical studies (Ajiboye, et., 2018; Tigist, 2017; Cole et al., 2013; Wollni and Fischer, 2015; Elabed et al., 2013; Mohammad et al., 2022; Timilsina et al., 2022; Sihem, 2019). The farmer characteristics include; gender particularly farmers' (i) socio-economic characteristics (*sex* and age, education level, household size, income); (ii) level of farmer organization and liquidity (ownership of a bank account, membership to farmer group, level of income diversification), (iii) knowledge and perceptions about agricultural insurance as well as; (iv) trust in the underwriters. The socio-economic characteristics of significance to the uptake of agricultural insurance include; sex and age, education level, household size, and income (Imilsina et al., 2022; Mohammad et al., 2022, Sihem, 2019; Partey et al. 2020; Hazarika & Yasmin, 2017)

3.2.1.1 Farmers' gender characteristics

Regarding age, the studies observe that older farmers are more likely to invest in risk management by purchasing more insurance premiums and vice-versa. The argument is that they are more likely to be risk-averse. Regarding income, Giné and Yang (2015) found that demand for rainfall-indexed insurance in Malawi was positively correlated with smallholder maize producers' income status. The key argument is that income determines the affordability of agricultural insurance. In India, Cole et al. (2013) established that insurance subsidies reduced insurance premiums which increased the liquidity position of credit-constrained farmers and their ability to afford agricultural insurance. Similar findings regarding the effect of credit are reported by Arida, Bordey & Luis (2017). The level of farm income was directly provided by farmers and correlated with uptake of and willingness to pay for agricultural insurance before they were entered into the regression model to predict their uptake effect. The probability of insurance uptake was found to be significantly higher for those who have access to non-farm income (Hazarika & Yasmin,

2017). Similarly, farmers belonging to social organizations or groups are more likely to access information through training or peer-to-peer learning about agricultural insurance and hence more likely to adopt agricultural insurance (Arida, Bordey & Luis, 2017). In terms of gender, men are found to be particularly more responsive in adopting climate risk mitigation measures and this is attributed to their ability to easily access information through training and telephones as well as finance for investment in climate-smart technologies (Partey et al.,2020; Arida, Bordey & Luis, 2017)

3.2.1.2 Level of farmer organization and household liquidity

Mohammad et al. (2022) observed that farmers' membership to a group had a positive significant effect on willingness to pay for flood insurance as a climate change adaptation strategy in northern Bangladesh. Similarly, Timilsina et al. (2022) observed a significant influence of farmers' membership in cooperatives on the adoption of banana insurance policy in Nepal. This underscores the significance of farmers' level of organization to the adoption of agricultural insurance. Regarding household liquidity, farmers owning a bank account and saving are expected to be financially literate and exposed with some degree of knowledge to easily appreciate agricultural insurance and hence more likely adopt it. In addition, they can easily access credit to finance agricultural insurance. Such farmers are perceived to have trust with financial intermediaries hence they are better placed to be receptive to the insurance concept. Specifically, for index insurance, Cole et al. (2013) and Cai et al. (2014) observe that the expected payout is more difficult to know because the relationship between weather and loss is not precisely known. Farmers must therefore trust that the set price is fair since the provider is likely to be more informed on risk than the farmer. Lack of trust results in an under-assessment and low willingness to adopt agricultural insurance. For example, Cole et al. (2013) observed that endorsement of the insurance product from a trusted third party increased uptake by 40% compared to farmers who heard no endorsement. This is notwithstanding the observations by Cai et al. (2014) in China that trust can be established by experimenting payouts to oneself or by witnessing payouts to members of one's social network.

Another line of argument regarding the effect of farm characteristics on the uptake of agricultural insurance relates to the level of vulnerability to climate change shocks. Specifically, this school of thought is related to household liquidity and level of income diversification which stood out in the literature on determinants for insurance uptake (Cole et al., 2012; Rhine et al., 2014). These studies operationalize the level of vulnerability in two dimensions. (i) household liquidity; (ii) the level of income diversification. The studies further operationalize household liquidity using two proxies that is; ownership of a bank account and savings. On the other, they operationalize income diversification using a proxy of having off-farm income as an alternative income. These farmer-related characteristics determine their capacity to absorb financial shock in case disaster strikes. Consistently, these dimensions of household liquidity and level of income diversification were adopted in this study to operationalize the level of vulnerability to climate shocks. The general notion is that; weather index insurance is a form of financial derivative through which farmers can hedge against climatic risk. Hence, the more liquid a household is and the more diversified its income is, the less likely it will adopt agricultural insurance due to high ability to absorb financial shock.

The above farmer characteristics and hypotheses around their effect on agricultural insurance uptake were embraced in this study considering that the target farmers in Bududa bear diverse gender characteristics which can potentially play out affect their perceptions, attitudes, willingness, or ability to demand agricultural insurance. The ideal expectation was that farmers who belong to farmers' groups, savings associations, or bear a savings account with a financial institution would more likely embrace agricultural insurance because of their possible knowledge exposure and provided they had positive experiences with financial service providers. However, it was also realistic to reason that such farmers would not be willing to take up agricultural insurance owing to their better liquidity position associated with the ease of absorbing financial shock. The other line or argument regarding the significance of farmer characteristics variables particularly membership to farmer groups and ownership of a bank account/savings relates to the potential effect theses variables bear on supply of agricultural insurance. For example, farmers' level of financial inclusion or financial literacy, their education level, as well as their membership in farmer groups can ease the cost of delivering insurance services. Hence, the potential linkage of

these factors to the delivery of agricultural insurance was explored from the perspective of the key persons implementing agricultural insurance support programs.

3.2.1.3 Farmers' knowledge and perceptions of agricultural insurance

Perceptions about the quality of agricultural insurance in terms of its relevance, the economic value of the indices or insurance premiums (basis risk), and flexibility in repayment terms were analyzed deriving from empirical studies by Timilsina et al. (2022), Ajiboye et al. (2018) Agaba, (2022); Clarke (2011) and Cole et al. (2013). The studies argue that farmers' knowledge influences their perceptions and subsequent willingness to adopt agricultural insurance. The studies identify basis risks as the major quality aspect of the insurance products basis risk which is the correlation between the return for the insurance product and the unpredictable resource or income deviations from the trend. If the absolute value of this correlation is small, then clearly the demand for this insurance product will be small (Clarke (2011). More relevant to farmers' perception is the price of insurance premiums.

3.2.2 Farm characteristics

Farm characteristics pronounced to affect uptake of agricultural insurance from empirical studies include: farm purpose, farm size, and a level of farm modernization or capital investment (Ajiboye et al., 2018; Sihem, 2019). The studies operationalize farm purpose in terms of whether farming is subsistence or commercial *(commercial vs. subsistence).* On the other hand, the level of farm modernization is looked at in terms of the magnitude of capital investments (Kassie et al., 2012; MOFPED, 2017). Low capital investment relates to using traditional farming technologies which are less costly as opposed to modern farming technologies. Farm size simply means the magnitude of land under production.

Notably, however, a critical analysis of arguments around the effect of these variables on the uptake of agricultural insurance seemed to lead to one fundamental factor that is: the economic significance of the farm which translates to the level of risk averseness and decision to adopt agricultural insurance. The convergence of these variables leverages the hypothesis that farmers who pursue farming for commercial purposes are likely to have bigger farms than subsistence farmers. Additionally, they are more likely to invest

substantially in modern agricultural technologies which are capital-intensive. Such include; hired labor, machinery, seeds, fertilizers, irrigation technologies, etc. Hence, they are expected to be more likely to be risk conscious and averse and therefore be more willing to adopt agriculture to shield their investments from losses. The effect of land size is further supported by Kassie et al. (2012) who observe that where resources such as land are scarce, scaling up the production of an enterprise by increasing for example land allocated to production is likely to increase the likelihood of a household adopting agricultural insurance. Similarly, a study by Arida, Bordey & Luis (2017) established that farmers with a smaller farm acreage had a higher probability of insuring their crops than those with a larger acreage.

In the context of the study, the agricultural insurance scheme in Uganda categorizes farmers by farm size and consider larger-scale farmers to be more likely to adopt agricultural insurance MOFPED (2017). However, in the context of smallholder farmers in Bududa was paramount to expand the analysis of the farm characteristics, create a clearer understanding and derive a theory of its effect. Hence, the effect of farm characteristics on agricultural insurance were analyzed

3.2.3 Quality of the insurance products

Quality of the insurance products on the supply side concerns; the design and attributes of the insurance indices. To this end, agricultural insurance indices are widely associated with "basis risks" and therefore unattractive since they are perceived not to compensate for the losses for which they think they are insured (Clarke, 2011; Carter, 2014). Basis risk refers to the differences that may occur between the actual loss incurred by the farmer and the loss determined by the index, entailing claims for none existent losses and no claims for actual losses incurred. This means therefore that individuals may suffer losses, but not receive payouts, or not suffer losses, but get payouts. Basis risk is mainly caused by perils such as pests and diseases that can cause catastrophic losses but are typically not captured by weather indices. Farmer behavior (e.g., planting date) is very difficult to capture in a formula set at the beginning of the season and creates the second-most common basis risk.

Theoretically, basis risk is divided into three types; spatial-for example, two villages dependent on the same weather station may suffer different losses; temporal where there may be some time between the event and the detection by the index and vice versa; and loss-specific where the index may inaccurately correlate with the real yield or not capturing all factors affecting crop (Carter, 2014). Notably, these basis risks are technical in nature and scientifically derived. To a farmer what makes sense in measuring the quality of the indices and would affect their attitude towards the insurance are their perceptions. Hence, from a farmers' perspective, the quality of agricultural insurance has also been perceived in terms of "client value". meaning that the index should offer value to farmers. The concept of "value" includes scope of cover meaning the extent to which the farmers' actual risk is covered. The other aspect is economic value where quality is perceived in terms of whether the dices make economic sense considering the premiums paid by the farmer and the indemnity payment for a loss. Quality is also operationalized in terms of additional benefits that come with the insurance package such as training, it's bundling with other services like access to inputs. Finally, the compensation approach matters where farmers tend to prefer revenue-based compensation over the cost-based approach (Carter, 2014).

Quality of the insurance products also means flexibility in premium payment: Insurance contracts normally require fixed payment and in advance of the farmer's income realization. If the insurance premium payments can be adjusted to the farmers' current circumstances, then demand should be higher. A case in point is the Kilimo Salama insurance offered by the Syngenta Foundation in Kenya (Kilimo, 2011) and Rwanda that links the premium payment for a rainfall-indexed insurance to the purchase of fertilizers, with a 50-50 cost sharing between the farmer and input supplier (Hamp and Laureti, 2011).

Because of the above empirical stance, the quality or economic value of the insurance indices/premiums was therefore measured by farmers' perceptions regarding whether the indices are commensurate with the magnitude of potential or actual loss, the timeliness and flexibility of their payments by the underwriters as well as the cost and price of index insurance/subsidies This, on the other hand, reflects the effectiveness of the indices or premiums, their economic sense or how free they are from the problem of basis risks, all which determine uptake of agricultural insurance. The perceptions were correlated with willingness to take up or pay for agricultural insurance and subsequently entered into the

regression model to predict their effect. The analysis further extended to the knowledge and perceptions to derive possible explanations for the perceptions. To this end, the extent to which farmers had accessed training on agricultural insurance was analyzed. Training access is expected to address complex issues of insurance products and enhance farmers' willingness to adapt. It empowers farmers with knowledge, and skills to understand and appreciate the quality of indices, insurance contracts, and purchasing and payment procedures of agricultural insurance hence building their adaptive capacity.

3.2.4 Quality of weather and farm data

They include; inaccurate, incomplete, and untimely availability of historical data on weather and crop yield in many countries (World Bank, 2019; Odening & Shen, 2014). This undermines the development of index-based insurance products with minimal basis risks. Official yield measurements are sometimes unreliable or biased and often reported quite late after the harvest, leading to delays in payment. Besides, microclimates and uneven topography may affect the yields greatly and these aspects are sometimes not accurately factored in the design of yield- Index-based agricultural insurance (Bageant & Barrett, 2017). In some communities, weather stations are beyond the 30km recommended for recording weather data (Clarke and Kalani, 2011). Lessons learnt from a study by Joab et al. (2017) on index-based agricultural insurance as a tool for adaptation to climate change by smallholder farmers in Africa indicate that agricultural insurance has limited commercialization among smallholder farmers and where meteorological services are limited in terms of proximity to farms, which therefore calls for public sector support. Drawing from these empirical perspectives, this study, therefore, conceptualized data-related challenges as data quality issues that were hypothesized to arise from the weaknesses in the data collection system as well as the geographical context of the farmers. The systems for data collection can involve a complete package of financial resources, approaches, tools, and technologies which largely dictate the capacity for quality data. The system should be built to match the contextual challenges such as the geographic spread of farmers and the terrain. A deeper engagement on these issues provided valuable insights into the data quality issues and the underlying challenges and their implication to the design of quality indices.

3.2.5 Insurance delivery approach

The insurance delivery approach is another supply-side factor identified to constrain the up-take of agricultural insurance (Cole et al., 2013; De Bock and Gelade, 2012; Hill et al., 2014). The argument is that delivery channels have a bearing on transaction costs and the final price of the insurance which ultimately affects affordability on the demand side. On the other hand, distribution channels are looked at from the perspective of the supplier or service provider with evidence indicating that the type of service provider affects trust. While some farmers have trust in public institutions as non-exploitative due to their non-profit motives, others trust the private service providers as they associate them with reliability and efficiency (Gelade, 2012; Hill et al., 2014). In the context of this study, agricultural insurance is promoted through a public-private partnership approach although the private players specifically the insurance companies and banks directly sell the insurance to farmers or indirectly through the Agro-consortium. Besides, the Agro-consortium implements the insurance subsidy on behalf of the government, hence the need to investigate farmers' trust in this implementation arrangement.

The payment period also known as the "framing effect" is also another insurance supply dimension underscored to affect the uptake of agricultural insurance. The framing effect suggests that delayed premium payments foster insurance demand drawing from empirical experiences in Borkinfaso (Serfilippi, Carter & Guirkinger, 2020), Ethiopia (Wasti et al., 2022) and China (Liu, Chen & Hill, 2020). Frame insurance allows farmers to access crop insurance at the beginning of cultivation and pay the premium after the crop harvest. In a low-yield year, farmers receive their payout after subtracting the premium; in a high-yield year, they pay the premium at harvest time after selling their crops (Serfilippi, Carter & Guirkinger (2020). Experience in Kenya showed that "pay-at-harvest" insurance shifts the insurance premium from the sowing season to the harvest season, bringing the premium and projected payout closer to parity which is preferred by farmers (Casaburi & Willis, 2018). In the context of this study, the framing effect was worth investigating considering that it seemed to bear relevance in addressing the income constraint associated with the low affordability of agricultural insurance.

CHAPTER FOUR

METHDOLOGY

This chapter presents the methods which guided the study in accordance with the research questions. The chapter first presents the philosophical orientation of the study opening insight into the mixed methods research design which has also been unpacked. Notably, the quantitative methods helped to collect and analyze data to identify the determinants of agricultural insurance uptake from the demand side presented in chapter six. On the other hand, the qualitative methods helped to collect and analyze data to assess how agricultural insurance is mainstreamed in the institutional framework for climate change adaptation presented in chapter five. The qualitative method further helped to collect and analyze data to assess the challenges and opportunities for uptake of agricultural insurance from the supply side presented in chapter seven. In line with the qualitative and quantitative approaches to the study, the chapter presents the study population and sample size. The chapter further presents the sampling methods for the quantitative and qualitative respondents. In addition, the chapter presents the methods for collection and analysis of the data as well as the data quality control measures. The chapter ends with a presentation of ethical issues and how they were addressed.

4.1 Philosophical orientation of the study

Considering the purpose and questions posed in this study, the pragmatic paradigm was found to be suitable, borrowing from the works of (Creswell, 2017; Saunders et al., 2011). The paradigm fits together the insights provided by the quantitative and qualitative research into a "workable solution" to answer the multifaceted research questions and offers practical solution in "real world". In the context of this study, the pragmatic philosophy allowed collection and analysis of qualitative and quantitative data to provide a better and deeper understanding of the study phenomena in line with the research questions.

4.2 Research design

The study adopted a mixed methods research design. This strand of research design bears much credence in the literature of Mixed Methods Research (MMR) in social scientific research. Although the intention in this section is not to delve deeper into its scientific elements but it is worth noting that MMR has attracted wide empiricism overtime considering for example progressive works by Creswell (2012; 2014; 2017). This author and many others universally agree and rationalize MMR for its ability to combine quantitative and qualitative methods to obtain deeper insights into or holistic understanding of the research phenomena. This ultimately enhances the rigor and credibility of research evidence.

According to the MMR leverages on the assumption that one type of approach or methods is insufficient to collect and analyze data to answer the different questions but rather a mixed of approaches (qualitative and quantitative) is ideal (Creswell et al., 2014). In Principle, application of mixed methods must consider the purpose and order of mixing as well as identify the major approach and the supporting approach. It is assumed that one approach plays a supportive or secondary role by addressing part of the research questions or complimenting the other to eliminate data bias and enhance credibility of emerging evidences (Creswell et al., 2014). Hence, MMR has an inherent attribute of ascertaining patterns, replication, or contradictions of findings to produce a strong support for the theoretical proposition (Saunders et al., 2012). Recent proponents of MMR observe that it has gained momentum in the field of social and behavioral sciences. (Timans, Wouters & Heilbron, 2019; Wasti et al., 2022), dictated by nature of research questions. Bressan, et al. (2017). Despite its strength, application of MMR remains limited (Younas, Pedersen & Tayaben, 2019; Ma, Su & Wang et al., 2021) and has been associated with challenges including; limited technical capability to apply it as well as its high cost of time and financial resources.

Owing to the above arguments on the significance and applicability of mixed methods research design, this study also applied the mixed methods research design for two reasons. One to address the research questions some of which necessitated qualitative data and others necessitated quantitative. Secondly, to eliminate bias and realize the much-needed

rigor and credibility of emerging empirical evidences. Specifically, the triangulation dimension of mixed design was used leveraging on the notion that one method is insufficient to generate unbiased and credible data to a research question. Hence triangulation is widely recommended as dimension of mixed methods research for its ability to eliminate data bias, offer confluence of evidence that ultimately breeds research credibility.

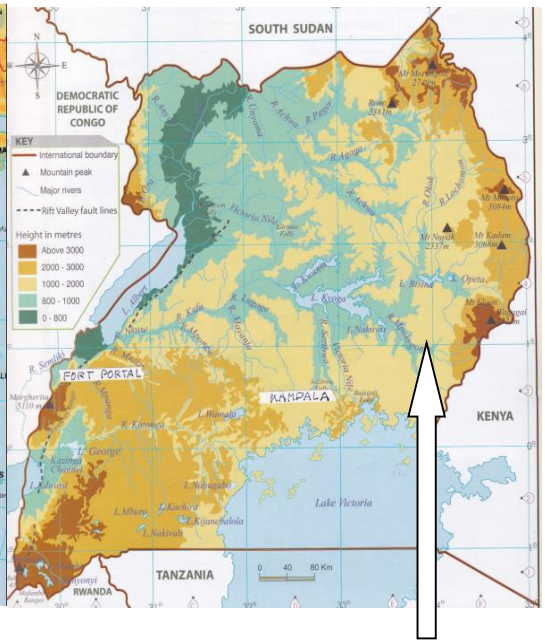
Triangulation involved a combination of qualitative and quantitative methods in sampling, collection and analysis of data provided more comprehensive understanding of the study phenomena consistent with the assertion by Creswell (2014). The study applied mainly qualitative methods which were triangulated with quantitative methods in collection and analysis of data. Specifically, the qualitative methods helped to collect and analyze data to assess how agricultural insurance is mainstreamed among the strategies in the institutional framework for climate change adaptation, the challenges and strategies for uptake of agricultural insurance from the supply side. On the other hand, the quantitative methods aimed to collect and analyze data to determine the determinants of agricultural insurance uptake from the demand side specifically farmers' characteristics and perspectives as well as the farm characteristics. The descriptive evidence and statistical significance of the factors would open further insight into the challenges and strategies for insurance uptake and triangulate these with evidence from the qualitative analysis

In terms of the order of mixing, the methods were applied concurrently, where document review and analysis were undertaken while drawing lessons and informing the design of data collection tools for key informant interviews and questionnaire survey. During analysis of questionnaire data, data from interviews would be reflected on to compare with informant view or derive meaning of the key statistics generated. Similarly, during analysis and interpretation of interview and questionnaire data, some key documents would be consulted for triangulation of emerging evidence with existing facts in the policy, plans and programme documents on agricultural insurance or climate change adaptation.

4.3 Study population

The study targeted an approximate population of 45 key informants for the qualitative component of the study. The choice of these categories of key informants premised on the fact that by virtue of their role towards promoting agricultural insurance and (or) climate change adaptation, they are better positioned to inform the study. For the quantitative approach, the study targeted a population of 44,861 small holder farming households in Bududa which are prone to agricultural risks associated with climate change (Bududa District Local Government, 2016). The district is located in the Eastern region of Uganda, a landlocked country in Africa. as indicated in figure below

Map showing location of Uganda in Africa



Map showing location of Bududa district in Uganda

Uganda has a population of 49.1 million people, 44.9% of whom is in the working age bracket (16-64) and 66% is employed in agriculture (Uganda Bureau of Statistics, [UBOS], 2020). The agricultural sector remains more vulnerable to climate change despite its significance to Uganda's socio-economic development owing to its estimated 24% contribution to Gross Domestic Product (GDP) and 34% contribution to export earnings (UBOS, 2020). Bududa district has a population of approximately 248,600 people and the majority (56%) rely on subsistence agriculture for a livelihood with Maize, millet, sorghum, Beans, and Groundnuts as the main staple crops (UBOS,

2020). According to the vulnerability assessment report, Bududa district is highly vulnerable to floods and landslides which arise from climate change and remain a major threat to agricultural production and productivity in the district (MWE, 2016).

Notably, no particular consideration was made to the characteristics of farmers except for their location where those who resided in sub-counties or areas more prone to climate risks such as the steep slopes and valleys were targeted. This kind of randomization subsequently enabled characterization of farmers by their demographic and farm characteristics. A summary of the categories of respondents, their respective populations, sample size and sampling methods is provided in table 4.1

Table 4.1: Target population of key informants

Category of respondent	Population	Sample	Sampling methods	Data collection method
International Agencies working on climate change-FAO, DFID, UNDP, DFID, USAID	4	2	Purposive	Interview
Insurance providers (APA, Gold Star, Lion, Phoenix, Jubilee, UAP, CIC, FIC, NIC, Pax)	10	5	Purposive	Interview
CC & AI focal persons in ministries-MAAIF, MWE, MOPED	6	3	Purposive	Interview
District Technical and Political Leadership- CAO, AOs, TPCs, DMCs	8	4	Purposive	Interview
CSOs	5	3	Purposive	Interview
Farmer Group Leaders	10	4	Purposive	Interview
Farmers	44,861	380	Simple random	Survey
Total	**44,904**	**401**		

Source: Population generated through consultations with the key stakeholders at national and district level. Sample size for farmers derived from Krejcier and Morgan (1976) sample size determination table

The Ministry of Water and Environment is the national coordinating body for climate change in Uganda. It manages implementation of climate change adaptation and mitigation interventions. It is supported by five ministries (Ministry of Water and Environment,

[MOWE], 2015). The MOFPED finances and monitors climate change implementation interventions funded through the ministry. MAAIF manages implementation of climate change adaptation interventions related with agriculture since the sector is among the most vulnerable to climate change shocks. Under the decentralized model of Governance in Uganda, the MOLG provides oversight to climate change programs at district level. UNDP, FAO, USAID, DFID and GIZ are international development agencies which have mainstreamed climate change adaptation and (or) agricultural insurance into their Uganda country programs. For example, UNDP coordinates inter agency responses on climate change adaptation. Funds from the Global Environmental Facility (GEF are channeled through UNDP also pioneered and supports implementation of the Climate Change National Adaptation Policy Actions (NAPA). It also takes lead on implementation of the Sustainable Development Goal (SDG) 13 on climate change.

FAO provides implementation support to national and local projects designed specifically to address climate change adaptation. Specifically, FAO supported development of the institutional framework for climate change adaptation in agriculture in Uganda and led the preparation of the country's National Adaptation Plan (NAP) framework. USAID funds research and capacity building interventions for climate change adaptation through programs such as "enabling environment for agriculture activity". USAID through the feed the future program is also promoting agricultural insurance. Notably, the above ministries and international agencies have designated focal persons in-charge of climate change adaptation who will be of interest in informing the study. For instance; the Climate Change Advisor at DFID; the Team Leader-climate change and energy at UNDP; the Program Manager for climate change at FAO; the Commissioner for climate change within the climate change department at the MWE; and the Climate Desk Officer at the MOFEPD.

At district level, climate change adaptation stakeholders relevant to agricultural insurance are: the political leaders (Local Council V); technocrats including; the Chief Administrative (CAO), Agricultural Extension Officers (AEOs), the District Technical Planning Committee and the Disaster Management Committee. The Local Council Chairpersons at District and Sub-county levels oversee implementation of Government programs, climate change adaptation inclusive. The Agricultural Extension Officers at District and Sub-

county levels manage implementation of agricultural extension programs including those related with climate change adaptation. The Disaster Management Committees at District and Sub county levels support implementation of climate change programs. Non-governmental Organizations (NGOs) and Community Based Organizations implement climate change adaptation programs and project interventions inclusive of agricultural insurance. They also support the District Local Government climate change structures in adaptation programming.

4.4 Sample size determination and sampling methods

For the qualitative component of the study, adequate sample size is a critical consideration owing to its implication on the quality and trustworthiness of qualitative data. It is characterized by the inclusion of an adequate number of "information-rich cases" often selected purposively (Fusch & Ness, 2015). However, determining an adequate sample size in qualitative research has been the subject of enduring discussion (Henninka & Bonnie, 2022). Notably, this section does not intend to delve much into the existing criteria for justifying sample sizes in qualitative research but rather highlights the meaning and applicability of the principle of saturation which was used to justify sample size adequacy in this study.

The principle of saturation remains the most popularly used method or argument to justify sample adequacy (Carlsen & Glenton, 2011; Baker & Edwards, 2012; Vasileiou, Barnett & Thorpe, 2018; Saunders, 2016; 2017). The saturation principle takes two forms that is thematic saturation and theoretical saturation. The former means continued inclusion of stud participants until no new themes emerge (Glaser & Strauss, 1967 as cited in Vasileiou, Barnett & Thorpe, 2018). The latter allows data collection until data can create a sufficient theoretical account of 'theoretical sufficiency' (Dey, 1990 as cited in Vasileiou, Barnett & Thorpe, 2018). The theoretical dimensions assume that data collection is less likely exhaustive but rather the ability of collected data to explain a problem is quite paramount.

In the context of this study, a sample size of 21 key informants was used based on the principle of thematic saturation. Notably, the sample size was adequate to create a theoretical account of how agricultural insurance is mainstreamed as the climate change

adaptation strategy as well as the prevailing challenges and strategies for insurance uptake. This sampling technique was applied to include respondents in the study who by virtue of their position or role in promoting agricultural insurance or climate change adaptation were expected to be more likely to have comprehensive knowledge for deeper engagements on the issues under study. Specifically, purposive sampling allowed the inclusion of relevant technical persons in the government ministries who are in charge of providing a strategic direction to the design and implementation of the institutional framework for climate change adaptation and agricultural insurance at national and district levels. Additionally, care was taken to include; the Civil Society Organizations which support the government in implementing various climate change adaptation programs with a focus on promoting agricultural insurance. Equally important, purposive sampling ensured inclusion of International Development partners that support the government or Civil Society Organizations in promoting agricultural insurance.

For the quantitative component of the study, specifically, the farming households, Krejcie and Morgan (1976) sample size determination table **(Appendix 1)** was applied to determine the sample size. The sample size table was preferred because it readily provides sample sizes for finite populations which can adequately represent and generalize statistical evidence to the respective population sizes. According to the table, a sample of 380 farmers would be adequate to generate statistical inferences which could be adequately generalized to the population of farmers under study.

To select the individual farmers, the study adopted a multi-stage sampling procedure. First, the specific sub-counties in the study district were selected using purposive sampling to ensure the inclusion of the sub-counties where the Agro-consortium, a private insurance company hired by the Government of Uganda, had implemented agricultural insurance awareness and sensitization programs to promote farmer uptake of agricultural insurance. A list of farmers was obtained from the Agricultural Officers in the sub-county localities. Each of the farming household was assigned a unique identification number from which a random sample was selected using the tottery method recommended by Amin (2015). This sampling technique eliminated bias in selection of respondents to allow statistical analyses.

4.5 Data collection methods

Given the nature of the questions that dictated the data requirements, the study used three sequential approaches for data collection. First, document review was done not only to identify the existing secondary data on the research questions but also to obtain insights on the key issues or variables in the subsequent collection of primary data from the key informants and farmers. A detailed description of these methods is presented hereunder. Alongside this, the data collection instruments are highlighted.

Document review: Document review was used to explore the strategic positioning of agricultural insurance in the relevant climate change policies, plans, strategies, and programs in the national adaptation framework. Specifically, the review assessed how agricultural insurance is positioned in the climate change adaptation framework of the relevant public institutional structures including; the relevant ministries and support agencies as well as the Local Government structures. To this end, relevant policy documents, plans, strategies. programs and performance reports on climate change adaptation and agricultural insurance were reviewed. The review also extended to available online research on approaches that have proven effective in promoting agricultural insurance both in Uganda and other countries. To this end, the review sought to identify any available data on the challenges to promoting uptake of agricultural insurance. Information gathered lent useful insights to the key informant interviews and the household survey in terms of the critical issues or variables on which primary data was elicited. On the other hand, information got from documents helped to triangulate the views of the key informants as a matter of ensuring the truthfulness of the informant's views. Consistently, document review is recommended as a qualitative data collection method for its ability to triangulate data from other methods on the same phenomena (Bowen, 2009). The review was guided by a standard checklist. **(Appendix 2).**

Key informant interviews: Key informant interviews were conducted on a purposively selected sample of respondents at national and district levels. The interviews helped to triangulate data from the document review regarding the strategic positioning of agricultural insurance in the relevant climate change policies, plans, and strategies. More importantly, the interviews enriched the study with in-depth understanding of the prevailing

gaps in mainstreaming agricultural insurance in the climate change adaptation framework, the prevailing challenges as well as strategies and opportunities for promoting agricultural insurance uptake

The interviews were standardized using an interview guide **(Appendix 3|** which was designed with open-ended questions to allow probing and obtain deeper insights into the study phenomena as recommended by Creswell (2014). The interviews were conducted at the key informants' places of work to offer them convenience and willingness to participate in the study owing to their busy work schedules. In addition, the interviews were kept as short as possible approximately 45-60 minutes to avoid respondents' fatigue which would undermine the quality of responses. Each interview was moderated by the Researcher with the help of a Research Assistant who specifically took notes and recorded the discussions.

Household survey: A household survey was conducted on a selected sample of farming households. The objective was to collect data that can indicate the potential for scaling up agricultural insurance in such communities; the opportunities which can be harnessed and the constraints which may have to be addressed. Data was collected on the farmers' characteristics represented by the household head including, their sex, age, education level, and household size hypothesized to affect the uptake of agricultural insurance. Additionally, data on farmer characteristics extended to their awareness and knowledge, attitudes about agricultural insurance which were hypothesized to have a bearing on their willingness and ability to adopt agricultural insurance. Besides, data on farmers' access to opportunities for learning about and demanding agricultural insurance. Data was also collected on the farm and farmer characteristics. Data was collected using a questionnaire **(Appendix 4),** structured with mainly closed-ended questions purposely to limit responses within defined ranges for easy coding and entry into the software for quantitative analysis. Owing to the huge number of respondents, the data collection exercises were supported by a team of trained Research Assistants who, through face-to-face interviews, administered the questionnaire to the sampled farmers from their respective households. The Research Assistants were knowledgeable about the study context and spoke English and the local language "Gisu", hence able to easily administer the questionnaire.

4.6 Data analysis

Data analysis used both quantitative and qualitative methods in line with the mixed methods research approach. The entire analysis was guided by the framework in figure 4.1

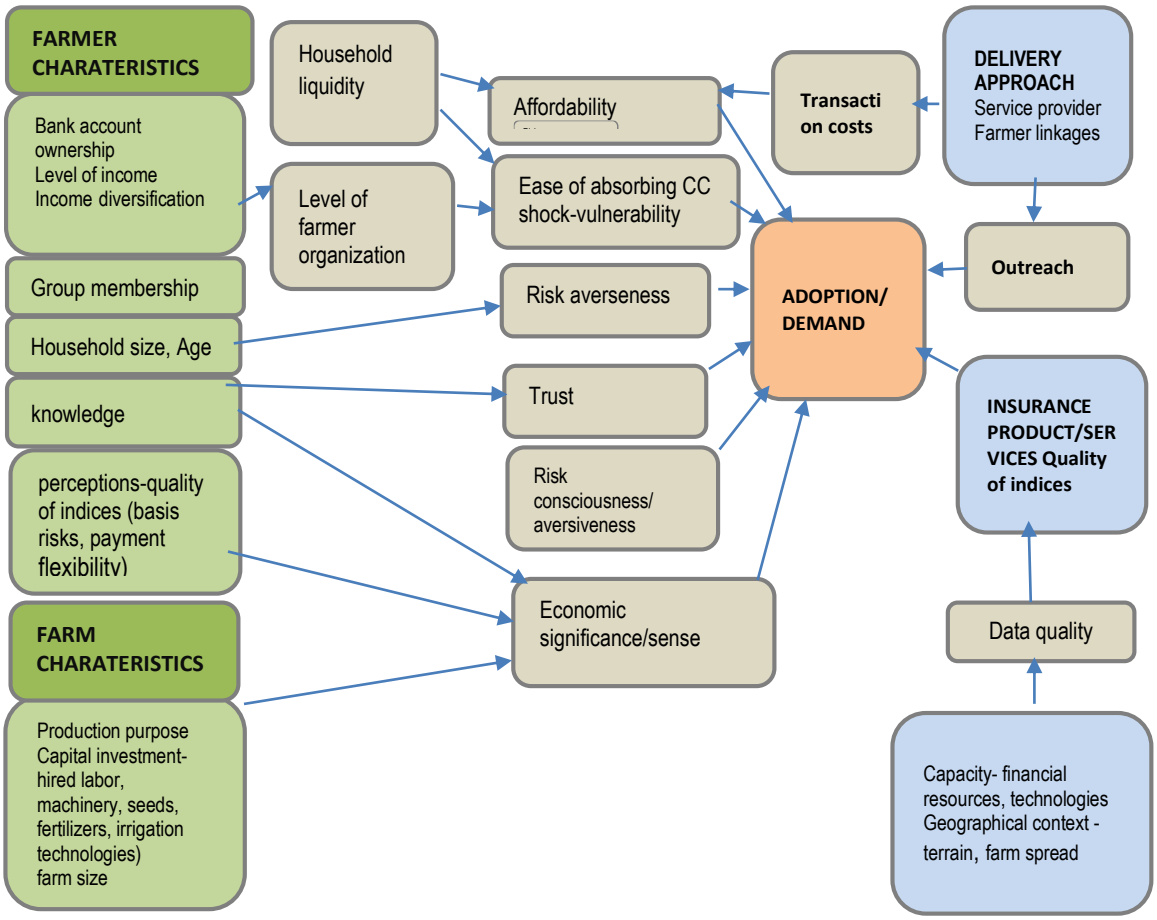


Figure 4.1 Conceptual/analytical framework for analysis of determinants for farmer adoption of agricultural insurance: A nexus between the demand supply side factors

The above analytical framework was developed to guide both the quantitative and qualitative analyses of the determinants for adoption of agricultural insurance in the context of this study on small holder farming communities vulnerable to climate change in Uganda. The framework drew from the theoretical assumptions and empirical literature presented in the previous chapter. The literature opened insights into the key demand and supply side factors which would bear significance to adoption of agricultural insurance. The literature further opened insights into the potential relationship between the demand and supply side factors and how they manifest to affect demand for agricultural insurance

As a guide to the color coding, the orange-colored box presents adoption of agricultural insurance also regarded as the dependent variable or key problem analyzed in the study. Highlighted in the dark green box are farm and farmer characteristics representing the primary demand side factors which were hypothesized to affect adoption of agricultural insurance. Their respective measurement proxies or constructs are presented in the light green boxes. Their effect on adoption of agricultural insurance was statistically tested or analyzed quantitatively. Highlighted in blue-colored boxes are the primary supply side constraints which were expected to affect adoption of agricultural insurance. Their effect was analyzed qualitatively. In grey color are the causal mechanisms through which the primary factors both from the demand and supply side perspectives were expected to manifest to affect adoption of agricultural insurance. From the above conceptual framework, the various quantitative (statistical) and qualitative (none statistical) analyses were derived in accordance with the mixed methods approach of the study.

4.6.1 Qualitative analysis

Qualitative data were analyzed using thematic analysis are commended by Creswell (2017) and Saunders, et al. (2018). According to the authors, thematic analysis allows deriving general trends from the views of key informants to support the pre-determined themes in line with the key issues under investigation. In the context of this study, the key issues analyzed on the supply sides relates with; the institutional provisions for agricultural insurance in the climate change adaptation framework, the extent and nature of support towards promoting insurance access such as; delivery structures/channels for agricultural

insurance and funding towards agricultural insurance. On the demand side, specifically farmers, the analysis generated themes regarding the insurance uptake drivers and challenges on aspects of farmers' awareness and knowledge about agricultural insurance, their ease of accessing agriculture insurance services, and their affordability of agricultural insurance-whether it is within their purchasing ability, their sense of efficacy towards agricultural insurance, their perception on quality or economic value of insurance indices/premiums in terms of amount and timeliness of premium compensations compared with the magnitude of loss suffered.

In terms of procedure, which was though iterative and reflective, the transcribed data was coded by providing labels representing clear, concise and conceptually meaningful units of data. The coding intended to look for patterns and "themes", recurrent data entities which bring meaning to recurrent experience and its variant manifestations. The themes were primarily guided by the theoretical assumptions of the study and previous empirical studies. As recommended by Saunders, et al. (2018) and Benard (2000). This was made possible through constant comparison of the transcribed notes to draw the theoretical and conceptual meaning of the data. Three coding methods were used that is; open coding which aimed at deriving concepts their properties and dimensions. Secondly, axial coding was done which involved making connections between data and putting similar data together through the use of coding paradigms including; context, intervening interactional strategies and consequences. This was made possible through constant comparisons that drew similarities, differences and relationships. Finally, selective coding was applied to select the core category, relating it with other categories, validating the relationships and filling in the categories which needed further refinement and development. This led to the identification of data patterns to draw a conceptual framework and theory arising from the data which was finally situated in or related to the theoretical underpinning of the study

In terms of strategies, data analysis first reflected on the: theoretical framework to help situate the data in the theory and understand the data. The research question was reviewed to ensure they were answered. Summaries were drawn help to create an understanding of the themes and subjected to peer review for validation. The background of the climate

change adaptation problem and agricultural insurance was reflected to better make sense of the present data. A visual display of data through conceptual frameworks was created and a narrative was written. The write-up involved developing metaphors or presenting data in various ways verbally, creating and collecting quotations that speak to the themes, eliciting the most important facts and finally writing up critical events in a chronological order.

4.6.2 Quantitative analysis

The quantitative analysis sought to characterize the households which have adopted agricultural insurance and determine whether they are significantly different from those who had not adopted the insurance. A regression model was fitted to predict the factors that significantly affect farmer adoption of agricultural insurance.

4.6.2.1 Descriptive analysis

To understand the climate risk problem and adaptation strategies in the study site, the descriptive analysis generated the percentage distributions of farmers' opinion on occurrence of climate risks of floods, droughts and landslides in terms of frequency and intensity. In addition, the percentage distribution of their opinion on adaptation mechanisms or measures were generated. To understand the extent of adoption of agricultural insurance which would open insight into the possibility of inferential analysis to test the determinants of adoption. The analysis generated percentage distribution of respondents on adoption agricultural insurance and went further to estimate the intensity of adoption in terms of the percentage of respondents by magnitude of insurance cover from the first time and as of 2022.

4.6.2.2 Inferential analysis

The inferential analysis used a Chi-square test and regression analysis. A Chi-square test was used to test whether there is a significant difference in proportion of adopters and none adopters across various farmers and farm characteristics as well as derive the mechanisms the significant characteristics manifest to affect adoption. In order to affirm the mechanisms through which farmer characteristics affect adoption, a chi-square test was conducted to test the significance of the association between farmers' socio-economic characteristics and

training access. It was hypothesized that these socio-economic characteristics would affect the adoption of agricultural insurance through their mediating effect on training

To affirm the effect of training on adoption of agricultural insurance and trace its manifestations, correlation analysis was conducted to test the hypothesis that "training has a significant positive relationship with adoption of agricultural insurance" Additional hypotheses were tested regarding the relationship between; training and knowledge about agricultural insurance, knowekedge and perceptions about agricultural insurance as well the relationship between the perceptions and adoption of agricultural insurance The analysis further used a Chi-square test to determine whether level of farmer organization indicated by ownership of a bank account and savings which reflected the level of household climate risk vulnerability had a significant association with adoption of agricultural insurance. Although the level of risk vulnerability could have also been tested using the level farm income diversification, the data was insufficient to allow the analysis as majority of farmers had no alternative source of income. They relied mainly on farm income

Regarding farm characteristics, the analysis used chi-square tests to test significance the significance of the association between farm characteristics and adoption of agricultural insurance. Specifically, the Chi-square tested the proportions between farmers who adopted agricultural insurance and those who never adopted across their farm characteristics including farm purpose, use of hired labor and use of modern farming technologies. Hypothetically, these aspects of farm structure were hypothesized to bear a significant positive association with adoption of agricultural insurance. These attributes of the farm determine its economic significance hence, the level of farmers' risk consciousness and willingness to adopt agricultural insurance.

The inferential analysis finally estimated a multiple logistic regression model to predict the significant determinants for adoption of agricultural insurance. A multiple regression model was fitted with variables operationalizing the characteristics of the farmers and the farm earlier hypothesized. Because of the high correlation between variables some variables or measurement proxies were excluded from the regression model. Farm characteristics were represented by farm purpose which reflects the effect of economic significance of the farm.

In addition, the effect of farmer access to training was tested in the regression model which was significantly related to the perception of relevance, importance and quality of agricultural insurance. In addition, membership to the farmer group and affordability of agricultural insurance were included in the regression model

4.6.2.1 Econometric model

Studies on constraints to the uptake or utilization of agricultural insurance which have mainly applied choice experiments and logistic modeling techniques (Liesivaara and Myrä, 2014) identify a variety of factors that determine farmers' preference for uptake or willingness to pay for agricultural insurance. To assess the determinants for farmer adoption of agricultural insurance and its intensity, the study utilized a two-step approach based on the discrete choice framework which assumes two decision levels including; the choice to adopt or not and the extent of adoption measured by the amount of paid premiums. Adoption has been widely estimated using regression models specifically the Logit model (Wanjira, 2021; Komarek, 2010). The sample selection model was in this study used to overcome the problem of missing data in the outcome equation as a result of incidental truncation arising from responses in the selection equation. This justification draws insights from Heckman (1978)

4.6.2.2 Model estimation

The econometric analysis of the determinants for adoption of agricultural insurance conceptually draws from the realm of random utility modeling which falls under the utility maximization framework adopted to explain the behavior of farmers under discrete choice. Mathematically, the utility maximization theory assumes that an individual has a choice to make between two mutually exclusive alternatives. The choice of alternative (x or y) is based on the individual's preference. This individual choice model is what is regarded as the utility maximization theory. The theory further assumes that an individual has a preference (P) among alternatives (x or y). The choice of x over y is denoted by (xPy). This model of choice based on the maximization of utility preference relation is also known as the rational choice model. The utility maximization theory remains a basic foundation for the classical demand theory in microeconomics. In the context of the uptake of agricultural insurance, farmers are faced with mutually exclusive discrete choices of whether to adopt

crop insurance or not. In this regard, the choice taken depends on the expected utility of their farm operations. The utility of a commodity comprises two facets namely: the deterministic element (U) is observable and the random error (ε) which is unobservable (Yang, 2014). Given utility that a household derives with and without agricultural insurance in its farming activities is U_i and U_k respectively, the n_{th} household will adopt agricultural insurance only if $U_i > U_k$. Consequently, the probability that n_{th} household will take up agricultural insurance can be expressed as:

$P_{nth} = U_i + \varepsilon_i > U_k + \varepsilon_k$ … (1)

4.6.2.3 Model specification

Both the choice to adopt and the intensity of adoption of agricultural insurance were used. The first stage involved a discrete choice model (Probit) where a correction factor 7 (probability of participation for those who did not participate) also known as the inverse Mill's ratio (IMR) is computed. The second hurdle involves an OLS model where the generated IMR is included as one of the regressors. The two-step model, therefore was represented as follows;

$\boldsymbol{zi} * = \alpha\, \boldsymbol{wi} + \boldsymbol{\mu i}$ … … … … … … … … … … … … … ………………………………(ii)

$\boldsymbol{Zi} = 1$ if $\boldsymbol{zi} * > 0$, and otherwise if $\boldsymbol{zi} * = 0$ … … … … … … … … … ……………...(iii)

Outcome/intensity equation; $\boldsymbol{yi} * = \beta\, xi + \lambda + \boldsymbol{\varepsilon i}$ … … … … … … … … … … … . ……(iv)

$\boldsymbol{Yi} = \boldsymbol{yi} *$ if $\boldsymbol{yi} * > 0$ and $\boldsymbol{zi} * > 0$, otherwise $\boldsymbol{Yi} = 0$ … ………………………………..(v)

Where $\boldsymbol{z} *$ and $\boldsymbol{y} *$ are unobserved latent variables determining the household's decision to adopt agricultural insurance and the premiums paid, Z and Y are the observed decision (to use crop insurance or not) and the amount of crop insurance bought by a household respectively, $\boldsymbol{wi}$ and $\boldsymbol{xi}$ are vectors of explanatory variables that influence household adoption and intensity decisions and λ is the inverse Mill's ratio. The explanatory variables are presumed to be uncorrelated with their respective error terms ($\boldsymbol{\mu}$ and $\boldsymbol{\varepsilon}$).

4.6 2.4 Variables: Determinants for uptake of agricultural insurance

Drawing from the conceptual/analytical framework on the determinants for adoption of agricultural insurance and with specific reference to the demand side factors earlier

presented in the conceptual/analytical framework (Figure 4.1), the variables which were hypothesized to affect adoption of agricultural insurance and tested statistically were derived and summarized in Table 4.2 The dependent variable adoption of agricultural insurance was hypothesized to be influenced by two explanatory variables that is; farmers' socio-economic characteristics and their farm characteristics. The respective measurement proxies or constructs are presented in the table as well as the expected nature of effect.

Table 4.2: Variables for quantitative analysis

Variable Description	Proxies for descriptive and (0r) correlational analysis		effect
Dependent variable	Adoption/uptake/demand *[farmer bought insurance; 0=yet to buy insurance]*		+/-
Explanatory variables	**Constructs/measurement proxies**	**Casual mechanisms**	
Farmer's Socio-economic characteristics	Age: Number of years Sex: [1=male; 0=female] HH size *[no. of household members]* Farm income *[Average annual earnings]* Farm income diversification *[1-=possess off-farm income [0=no off-farm income]* Access to insurance subsidy [*1=yes, 0=no]* Membership to farmer group *[member of a farmer group; 0=none member]* Ownership of a savings account *[1=yes, 0=no]* Possession of savings: *[1=yes, 0=no]*	Risk averseness Level of insurance affordability Ease of absorbing shock/level of household vulnerability	+/-
Quality of agric. Insurance (farmer perceptions)	Relevance of AI *[1=relevant; 0=irrelevant or no sure]* Price/cost of insurance: *[1=affordable; 0= not affordable or not sure* *Economic value of indices [1=commensurate with loss; 0=not commensurate]* *Timeliness of payment [1=paid timey; delayed payment]* *Access to training [1=trained in agric. insurance; 0=never trained in agric. insurance]*	*Trust in the indices and insurance services*	+
Farm characteristics	Farm purpose *[1=semi-commercial or commercial]; 0=subsistence]* Level of capital investment: *[1=Use of hired labour and/modern technologies e.g machinery, fertilizers, improved verities; 0=use traditional technologies]* Farm size: Hectares of farm land]	Economic significance of farm enterprise	+

4.7 Quality control

For the quantitative data and specifically the questionnaire, validity and reliability were tested as control measures. Validity indicated the extent to which the questions measured the constructs of interest in the study while reliability indicated the extent to which the questionnaire was consistent in measuring the constructs. Validity of the questionnaire was tested using the CVI (Content Validity Index), expressed as: CVR= (ne-N/2)/ (N/2 where ne = number of subject matter experts who rated the questions as "essential", and N = total number of subject matter panelists. The experts rated 43 questions out of which 93% were considered essential, a proportion which was greater than the 0.7 recommended by Nunnally (1967) for the instrument to be valid. For reliability, a test-retest method was used where a questionnaire was administered to 10 respondents and re-administered to the same group after one week. The two data sets were entered in SPSS and a Cronbach's alpha statistic estimated. The statistic was 0.83 or 83% which was above the 70% the minimum acceptable level of reliability according to Yin (2011).

For the qualitative approach, the study strived to ensure trustworthiness of the research findings by employing measures to ensure credibility, transferability, dependability, and confirmability as recommended by Norman, Stahi and King (2020). Credibility was enhanced through data triangulation by interviewing different categories of respondents including insurance companies, farmer representatives, and technocrats in the selected ministries.

Transferability was ensured through providing a detailed description of the study site that is climate change adaptation in Uganda and Bududa district. Consequently, potential users of the study findings will be able to ascertain applicability of the findings to other context farming contexts as a matter of transferability. To ensure dependability, the transcribed notes were subjected to peer review to ensure that the viewed captured were comprehensive enough. In addition, the emerging findings from the analysis were subjected to peer review by the same faculty member who had reviewed the notes to ensure they largely reflect the views of respondents rather than the researcher.

4.8 Ethical considerations

In recent decades, ethical considerations in research and academic communities have become more intense largely stemming from the legal changes related to human rights and data protection as well as increased public concern for research and discovery restrictions. (Vilma, 2018) Ethics are the norms or standards for conduct that distinguish between right and wrong. Like any study involving human participants, the study was associated with several ethical issues for which measures were provided to address them. The ethical issues include; potential harm to study participants due to invasion of privacy associated with disclosure of individual respondents' specific information, bias, violation of intellectual property rights, dishonesty and subjectivity, illegal conduct among others. These issues have roots in the literature on research ethics for example, Hickey (2018), Ichendu (2020), Akaranga & Makau (2018) & Vilma (2018). A letter for ethical review and clearance is provided in Appendix 7. Before ethical clearance, the study had obtained clearance for field work from the university (Appendix 5) and a no objection from the Agro-consortium, an umbrella of insurance companies and banks promoting agricultural insurance through the agricultural insurance scheme of the Government of Uganda (Appendix 6). The ethical issues were managed by complying with recommended ethical principles in social science research including but not limited to beneficence, confidentiality, anonymity, volunteerism, objectivity and openness (Sen and Nagwanshee, 2016).

The entire package of these ethical considerations was integrated into a research proposal for this study which was reviewed by Makerere University School of Social Science Research Ethics Committee (MAKSSREC) and approved by Makerere Uganda National Council for Science and Technology (UNCST), a regulatory body mandated to approve all researches involving human subjects as participants.

To ensure protection of the participants, the principle of confidentiality was observed during data collection analysis and presentation or reporting. During data collection, names of respondents were identified on the questionnaires or interview notes but rather unique identification numbers for each respondent were used. Similarly, unique codes were assigned to the interviewees to identify the individual sources of information during reporting of findings or data presentation. In line with the principle of beneficence and to ensure participants appreciate potential benefits and thereby consent to share information objectively, respondents were oriented to the rationale, objectives, methodology and, potential use of emerging research evidence. The study participants were also introduced to the safety measures that were integrated into the methodology to ensure confidentiality and anonymity.

The principle of volunteerism was also adhered to by ensuring and informing participants that their consent to participate in the study is voluntary and free of any coercion. Care was taken to ensure that the consent form is administered by someone who did not hold authority over the research participant as recommended by Vanclay et al. (2013). Consent was obtained from all research participants using consent forms provided in appendices 8&9. for copies of consent forms. Other ethical principles which were observed include; honesty and integrity where research findings presented derived from the results in line with the data collected and methods used.

4.9 Summary

The chapter has presented the methodology highlighting the pragmatic philosophical orientation of the study as well as the qualitative and quantitative methods of data collection and analysis. The chapter finally presented ethical considerations emphasizing the ethical principles and how they were safeguarded. The proposed mixed methods research design and respective methods for collection and analysis of the data are aligned with the three research questions one of which necessitated quantitative data to estimate adoption of agricultural insurance and predict the significant determinants. The last two research questions necessitated qualitative data

CHAPTER FIVE

AGRICULTURAL INSURANCE IN UGANDA'S DEVELOPENT AND CLIMATE CHANGE ADAPTATION FRAMEWORK

In line with the first objective of the study, this chapter provides a critical analysis of how agricultural insurance is mainstreamed in Uganda's climate change adaptation and development framework. Findings draw from a critical analysis of data obtained from document review as well as key informant interviews. The next section highlights key episodes in the institutional framework for Uganda's climate change adaptation. The third section puts across critical observations on how agricultural insurance is aligned with the national and agricultural sector development framework as well as the climate change adaptation framework including; the Vision 2040, the National Development Plan III, the National Agricultural Policy, the National Adaptation Policy, the National Adaptation framework for Agriculture, the Agricultural Sector Strategic Plan, the Climate-Smart Agriculture Program among others. The last part of the chapter makes critical observations on the linkage of agricultural insurance with the Agricultural Finance Policy and analyses the agricultural insurance scheme a key government initiative towards promoting agricultural insurance. The analysis of the agricultural insurance scheme identifies its key strength and weaknesses with regard to promoting agricultural insurance as a climate change adaptation strategy

5.1 Uganda's institutional framework for climate change adaptation

The Government of Uganda through a public-private partnership approach has taken significant steps in addressing the climate change problem. The Government of Uganda has made commendable steps in building an institutional framework for addressing climate change. Uganda ratified to the United Nations Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto Protocol demonstrating commitment to the adoption and implementation of policies and measures designed to mitigate climate change and adapt to its impacts. Uganda developed and updated her Nationally Determined Contribution (NDC) in fulfilment of Article 4 of the Paris Agreement (MWE, 2022). The NDCs presents an ambitious economy-wide mitigation target in 2030 of 24.7% below the Business as Usual

(BAU), a progression from the 22% reduction target communicated in the first NDC in 2016 (MWE, 2022). The mitigation and adaptation actions outlined in this updated NDC are considered critical for realization of the country's commitments stipulated under the Paris Agreement, 2030 Agenda for Sustainable Development (SDG13), Sendai Framework for Disaster Risk Reduction 2015–2030, the post-2020 Global Biodiversity Framework, among others. The country is also a member of the East African Community (EAC) and therefore bound by the EAC climate change policy which urges partner states to develop consistent national policies to ensure harmonized actions towards climate change. This demonstrates commitment and obligation to develop and implement strategies at local and national levels to contribute to the overall goal of combating climate change. This leverages the current national framework to address climate change and its impacts.

At the national level, the adaptation and mitigation actions of the updated NDC are critical to realization of the country's aspirations in the Vision 2040, the National Development Plan III, the National Green Growth Development Strategy, the 10-year Environment Restoration Plan, among others. The NDCs identify climate change adaptation as number one priority to addressing key vulnerabilities in sectors, building adaptive capacity at all levels, addressing loss and damage as well as enhancing the resilience of communities, infrastructure and ecosystems (MWE, 2022). Addressing climate change in agriculture was first integrated in the country's National Development agenda specifically in the National Development Plan (NDP) for 2015/16–2019/2020 (National Planning Authority [NPA], 2010) and has since then been mainstreamed in the national developed agenda to-date (NPA, 2020). Mainstreaming climate change adaptation in the national development agenda underscores the significance of addressing climate risks among the strategies that can foster realization of Uganda' desired transformation from a Peasant to a Modern and Prosperous Country by 2040 (Government of Uganda [GOU], 2010). This framework is the blue print for long-term development towards realization of sustainable economic and social development. The development agenda identifies agriculture among the sectors which are likely to be more affected by climate change impacts and consequently provides for integration of climate change adaptation measures in agriculture programming at sectoral and local government levels. The development agenda provides strategies for management of climate change including: addressing the legal and institutional frameworks

necessary for the implementation of the UNFCCC; multi-stakeholder involvement in tackling the climate change issue; ensuring adequate resources for effective implementation of the committed strategies. Main streaming climate change adaptation in Agricultural programs and projects including; the National Agricultural Advisory Services among others.

The climate change agenda is guided by the National Climate Change Policy (NCCP) which was developed in 2012 to ensure a harmonized and coordinated approach towards a climate-resilient and low-carbon development path for sustainable development in Uganda (MWE, 2015[c]). The NCCP's sets to address key concerns of climate change adaptation and mitigation giving priority to climate change adaptation over mitigation. It provides a clearly defined pathway for dealing with the challenges of climate change within the socio-economic context of Uganda. The policy identifies agriculture among the priority sectors in promoting climate change adaptation. Specific emphasis is put on climate change adaptation strategies that enhance resilient, productive and sustainable agricultural systems; and promoting value addition, improving food storage and management systems towards enhanced food security and resilience. The policy underscores the need to; support policies and programs that take into account the interactions between population dynamics, support research and development, promote transfer and diffusion of climate-smart technology and information to better understand the impacts of climate change as well as support education, awareness raising and capacity development for a range of climate change stakeholders (MWE, 2015[c]).

In 2016, the NAP-Ag Framework was developed with adaptation strategies contextualized to different agro-ecological zones (MAAIF, 2016). A budget circular call (BCC) was issued by the Ministry of Finance, Planning and Economic Development requiring the mandatory mainstreaming of climate change into all sectoral budget framework papers and district local government plans, starting with the fiscal year of 2017/18 (MOFPED, 2018). The NAP-Ag identifies the following adaptation actions; expanding extension services, climate information and early warning systems, Climate-Smart Agriculture (CSA), diversification of crops and livestock, post-harvest handling and storage, access to markets, rangeland management, small scale water infrastructure, research on climate resilient crops and

animal breeds as well as expanding the use of off-grid solar system to support value addition and irrigation. In addition, a 10-year Climate Smart Agriculture (CSA) Program (2015-2025) as well as the Uganda National Climate Change Communication Strategy (UNCCCS) 2017-2021 were developed between the period 2015-2016. The Climate Change Communication Strategy outlines a comprehensive action plan that should be followed while communicating about climate change issues in Uganda. It addresses existing gaps in communication, coordination, and dissemination of climate change adaptation and mitigation information (MWE, 2016).

Further mainstreaming of climate change adaptation features the Uganda's National Land Policy which recognizes the impact of climate change especially in exacerbating the already degraded and fragile natural ecosystem. Through the policy, the government intends to address climate change mitigation and adaptation by: a) mainstreaming sustainable management of the environment and natural resources in its plans and programs; b) putting in place climate change adaptation strategies to reduce the climate impact on people and the economy and c) developing a framework for compliance with all international climate change commitments. These activities are set to be spearheaded by the Ministry of Lands, Housing and Urban Development (Ministry of Lands Housing and Urban Development, ([MOLHUD], 2013).

The government institutional structures supporting climate change adaptation in agriculture include; the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) responsible for providing a strategic direction to the implementation of climate change adaptation interventions as well as the Ministry of Finance, Planning and Economic Development which plays a financing role towards effective implementation of the climate change commitments (World Bank, 2019b; MWE, 2016). In addition, the Department of Meteorology within the Ministry of Water and Environment coordinates climate change activity for the MWE in its capacity as the National Focal Point for Climate Change under the UNFCCC. The Commission on Disaster Management & Refugees (CDMR) under the Office of the Prime Minister coordinates an effective response to climate induced disasters including; droughts, floods and landslides.

The National Agricultural Research Organization and universities such as Makerere conduct research developing climate-smart technologies such as drought resistant varieties and water resources management technologies. Agricultural extension organizations particularly the Ministry of Agriculture Animal Industry and Fisheries and Operation Wealth Creation work with the Local Government Agricultural Extension structures and NGOs to institutionalize, promote adoption and replicate the technologies. At district level which is the lowest governance structure at which climate change interventions are mainstreamed, climate change stakeholders include mainly; the political leaders (Local Council V and Local Council III Chairperson; Technocrats including; the Chief Administrative (CAO), Sub County Chiefs, Agricultural Extension Officers (AEOs), Environment and Natural Resources Officers (MWE, 2015). Another key category of private sector players in promoting climate change adaptation includes; financial institutions and Civil Society Organizations. The financial institutions categorically include; banks and insurance companies which either extend financial services directly as credit or indirectly through agricultural insurance to foster financial access and farmers' capacity to invest in climate change adaptation technologies. Civil Society Organizations are mainly engaged in creating awareness and promoting development and uptake of adaptation innovations (World Bank, 2019b).

However, key informant interviews identified that agricultural insurance is loosely mainstreamed in the above mentioned structures and programs promoting climate change adaptation. Specifically, the interviews revealed that there is limited emphasis of agricultural insurance in the mentioned institutional policies, strategies, programs and structures. Research with focus on promoting knowledge and technologies to foster climate change adaptation has had little attention to the problem of low adoption of agricultural insurance and strategies to promote its uptake. Similarly, agricultural programs providing extension support particularly at the local government levels of service delivery have not given agricultural insurance the much-needed attention. Efforts to promote farmer access to production and productivity enhancement technologies under the Operation Wealth Creation Program has not attended to the much needed agricultural insurance. Worth noting, one of the key informants had this to say;

"It is quite unfortunate that agricultural insurance has not been adequately attended to in the climate change adaptation programs and structures. Look at the research conducted. Look at the programs promoting climate change adaptation through the so-called climate smart agriculture. Look at the key agricultural extension programs formerly the National Agricultural Advisory services and currently operation wealth creation. Don't forget the program by the civil societies prompting agribusiness. The question is to what extent are they focusing on agricultural insurance. My honest opinion is that they barely have no focus on agricultural insurance. The most common scenario across these programs and structures is a mere mention of the relevance of agricultural insurance in the face of climate risks. There is barely no attention to mainstream it in the agricultural support programs and structures in order to promote its uptake" (KI5, July 2022)

In a nutshell, the above institutional framework identifies Uganda's development framework in pursuit of the vision to transform from a peasant to a Modern and Prosperous Country. The framework further identifies the potential hindrance climate risk bears to realization of the national development aspirations. Consequently, the, national development planning has mainstreamed climate change adaptation. Efforts have been made to build a robust institution framework for climate adaptation guided by the climate change policy. The policy has been operationalized through the National Adaptation Framework for Agriculture, the climate change communication strategy, the Climate Smart Agricultural Programme and the Budget Frameworks mainstreaming climate change adaptation interventions in the budgeting process. The implementation and management of climate change adaptation programs is mainstreamed in the agricultural extension system flagged off from the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) or the Ministry of Water and Environment (MWE) to the Local Government structures at District and Sub county levels of governance and service delivery.

The climate change adaptation interventions are coordinated through the National Focal Point for Climate Change under the UNFCCC in the MWE. Further support to climate change adaptation programs draws from research organizations largely; the National Agricultural Research Organization and universities. In addition, there are private sector organizations categorically including; financial institutions and Civil Society Organizations that provide support in terms of financing or technical assistance in development and delivery of adaptation programs. From the critical analysis of this climate change adaptation

framework, a critical question of how agricultural insurance is aligned with the national and agricultural sector development framework as well as the climate change adaptation framework emerges. This question is answered in sub-sections 2.3 and 2.4. The latter makes critical observations on the linkage of agricultural insurance and the insurance scheme with the climate change adaptation framework and farmers at the local level.

5.2 Agricultural insurance linkage with the national development framework

Agricultural insurance is quite relevant to the development aspirations at National level and the Agricultural sector specifically considering; the vision 2040, the National Development Plan III, and the Agricultural Sector Strategic Plan. Evidence of this alludes to the following observations and arguments. First, agricultural insurance is intended to manage climate risks and promote access to finance for investment in agricultural production and productivity enhancement inputs. This can ultimately enhance agricultural production, income, and food security. This is well aligned with the aspirations of the National Agricultural Policy and the Agricultural Sector Strategic Plan at sectoral level as well as the National Development Plan III and Vision 2040 at the national level. Putting this into context, the following observations are put across from a Researcher's critical analysis of the key insights from document reviews triangulated with the views of some key experts in national development programming.

The Government of Uganda through the National Development Plan II (NDP III) recognizes agriculture as the backbone of Uganda's economy and achievement of aspirations of this plan arguably necessitates investments in climate adaptation as a mitigant to climate risks which remain a key threat to agricultural production and productivity. In fact, the Agricultural sector is positioned among the key sectors for investment. This strategic recognition of the agriculture sector to national development is quite healthy considering its economic significance. The agricultural sector contributes 23 percent to GDP, 34% to export earnings and employs over 70 percent of the working-age population (UBOS, 2020). In fact, Under Vision 2040, Uganda aspires to transform from a Peasant to a Modern and Prosperous Country by 2040, and key strategic investments to promote commercialization among other aspects under the agricultural sector strategic investments will arguably necessitate managing climate risks through agricultural insurance. To affirm

this researchers' position regarding the alignment of agricultural insurance with Uganda's development framework, one of the key informants had this to say;

> *"Agricultural insurance is well aligned with Uganda's development framework. If you consider the National Development Plan, it is placing a lot of emphasis on the transformation of the agricultural sector which cannot happen unless farmers are insured. This is because of the high risks of climate change which means that farmers cannot make a significant investment to boost production and productivity. Without insurance, they cannot access credit from financial institutions which see farmers as very risky lend. I also consider agricultural insurance to be perfectly aligned with the agricultural sector development framework which calls for increased investment in production and productivity-enhancing technologies demanding a great deal of credit finance" (KII2, July 2022)*

The pursuit of the agricultural sector goals in the NDP is guided by the National Agriculture Policy (NAP) and the Agricultural Sector Strategic Plan (ASSP) for which agricultural insurance is central to the success of these agricultural sector development frameworks. The policy seeks to realize food and nutrition security as well as improve household incomes through sustainable agricultural productivity, value addition, and trade in agricultural products. Contributing to the achievement of the ASSP goals, the ASSP is strategically positioned to promote farmer access to productivity-enhancing technologies such as high-quality seeds and fertilizers. Consistently, the plan underscores the need to enhance access to agricultural finance which can be realized through agriculture risk management. On the other hand, the ASSP characterizes agriculture as highly prone to risks of production failure and crop loss which arise from climate hazards of drought and rainfall extremes. These are considered the biggest threats to farm production and productivity. Pests and diseases are also exacerbated by extremes of drought. In this context, agricultural insurance is quite paramount to mitigate climate risks thereby attracting credit finance for investment to address the farm production constraints. Consistently, this researchers' view regarding alignment of agricultural insurance with the National Adaptation Framework for Agriculture was affirmed by many key informants one of whom had this to say;

"Agricultural insurance is well aligned with the climate change adaptation framework for the agricultural sector. The adaptation framework identifies the need for the adoption of Climate Smart Agricultural technologies such as climate-resistant varieties or breeds, water harvesting technologies, and irrigation technologies among others. These technologies however cannot be adopted by poor farmers who therefore have to rely on financial credit which banks cannot provide unless a farmer is insured" (KI3, July 2022)

The relevance of agricultural insurance to the agricultural sector also stems from the fact that agricultural growth has remained slow due to low productivity. The researcher notes from review of various documents that; the low productivity has been partly linked to limited investment in climate-smart technologies amidst climate change hazards (IFAD, 2021). Uganda's agricultural output was estimated to be growing at only 2 percent annually lower than the 5.2% and 3% growth in GDP and the population respectively (Walker et al. 2015). In addition, the national total factor productivity in Uganda's agriculture is reported to be negative for the past 20 years (IFAD, 2021); and the use of improved seeds, inputs, and mechanized traction was estimated to be low. For example, only 10 percent of the farmers in Uganda use animal traction, and 1.2 percent use tractors (World Bank 2018). Consistently, yield gaps are estimated at 50-75% (AGRA 2017). It can therefore be argued that agricultural insurance therefore offers a viable solution for enhancing access to finance for investment in productivity enhancement and climate change adaptation technologies towards increased productivity. This researchers' argument is consistent with the is consistent with the views of key formants which rationalized agricultural insurance stemming from its potential to address the prevailing challenges of low agricultural productivity and slow growth of the agricultural sector. To mirror this argument from the perspective of key informants, one of them had this to say;

"Agricultural insurance is quite relevant to Uganda's agricultural sector considering the fact of its slow growth and low productivity due to limited adoption of modern production and productivity-enhancing technologies. There is no doubt that agricultural insurance has huge potential to promote farmer access to credit finance for investment in agricultural production and productivity enhancement technologies to boost the growth of the sector" (KI4, July 2022)

Another line of argument regarding the significance of agricultural insurance in the context of Uganda relates to the fact that agricultural financing is critical, yet farmers are poor to afford credit for investment in climate change adaptation. Agricultural financing through credit access is critical for small-holder farmers in Uganda to facilitate investment in climate change adaptation technologies and practices. Credit fosters investments in high-quality input, farm mechanization and irrigation technologies along with better practices, that allow farmers to adapt to climate change and minimize losses. Credit serves as an alternative source of survival in case of income loss due to production failure arising from climate risks. Uganda is listed among the countries most vulnerable and least adapted to climate change, scoring 155 out of 188 countries on the ND-GAIN index. Limited adaptation to climate change increases financial losses which discourage investment in agriculture and further undermine its potential to contribute to economic development.

In addition to the challenges which rationalize agricultural insurance, smallholder farmers lack access to agricultural finance. The majority are poor with small farm holdings averaging 0.8-1.6 hectares. Production is largely subsistence and rain fed with limited use of modern technologies. According to the Financial Sector Deepening Report [FSD] Uganda (2018), only 58 percent of farmers are formally financially included. Consistently, only 12.2 percent of overall credit goes to the agricultural sector, with only one-third of this going toward primary production. Compared to GDP, the agriculture credit for production is a fraction of 2.8 percent of agricultural GDP (Bank of Uganda [BoU], 2018). Although total agricultural credit has been growing in recent years, the current growth is still far behind the potential demand from smallholder farmers. Formal credit to production is expanding in well-organized value chains such as coffee and tea. Hence, agricultural insurance would address some of the barriers to accessing agricultural credit among low-income smallholder farmers. Consistent with these researchers' observations from document review, key informant interviews provided a strong attestation that indeed agricultural insurance is quite relevant to farmers in Uganda because of their low income or poor status and limited access to finance. In attest, one of the key informants had this to say;

" In Uganda, considering the majority of farmers earn low incomes. I strongly believe that agricultural insurance is the way to go. These low-income farmers can only make the much-needed big investments in farm production when they have access to credit for which they need insurance. This argument becomes meaningful considering the climate risks for which farmers need huge investments in adaptation technologies" (KI3, July 2022)

Agricultural insurance is also relevant to smallholder farmers given their high vulnerability to climate risk**.** Farmers lack access to finance mainly due to; the reluctance of financial institutions to extend credit to them and their limited demand for credit due high risks associated with farming. Farming is highly vulnerable to risks of production and post-harvest handling losses as well as market failures due to unpredictable quality and quantity of farm outputs due to production shocks exacerbated by droughts, landslides, and hailstorms that arise from extreme weather events. Extreme weather events are also a breeding ground for pests and diseases which further exacerbate production risks which are associated with the risk of market failures arising from limited investment in opportunities for market access. Addressing such risks, therefore, necessitates financial investments into adaptation practices and technologies yet farmers are poor with limited access to financial resources. Consequently, farmers continue to rely on rain-fed agriculture and lack access to climate-resilient or climate SMART technologies and practices as reported by World Bank (2018). This increases the likeliness of production failures which renders farm production risky to finance. Hence agricultural finance serves as a key mitigant to agricultural risks associated with climate change thereby fostering access to agricultural finance. Validity of this argument borrows credence from one of the key informants who had this to say citing the case of farmers in Bududa district;

"Farmers in Uganda are highly vulnerable to climate risk. Drought is a common phenomenon they rely on rain-fed agriculture. Others do farm on steep slopes which renders them highly susceptible to the risk of floods and landslides. This is very true for farmers in the context of this study which you have said is focusing on Bududa district one of the areas in the Mountain Elgon Zones where floods and landslides are common weather phenomena. Besides, the farmers in these rely mainly on framing for a livelihood with limited alternative income sources. They find it extremely difficult to adapt to climate risks" (KII7, August 2022)

Agricultural insurance is also well aligned with the already existing policy framework and programs to promote agricultural finance. The GOU has implemented several initiatives to promote agricultural financing. Through the Agricultural Credit Facility (ACF) established in 2009, Government provides interest-free loans to financial institutions lending to farmers. The government established the Microfinance Support Center (MSC) that promotes microfinance institutions (MFIs) and cooperatives which prioritize agriculture sector financing. The MSC provides business development support as well as wholesale and retail loans to Savings and Credit Cooperative Organizations (SACCOs), MFIs, primary cooperatives, Village Savings and Loan Associations (VSLAs), and small and medium enterprises (SMEs). Finally, the Agricultural Business Initiative Finance (aBi-Finance), a non-profit entity established by the Governments of Uganda and Denmark in 2010 to support agribusiness development and agriculture finance with credit lines and partial credit guarantees; it is currently supported by DANIDA (Danish International Development Agency), USAID (U.S. Agency for International Development), SIDA (Swedish International Development Cooperation Agency), and KFW. The most recent effort to promote farmer access to agricultural credit features is efforts to promote agricultural insurance to de-risk rural lending to Ugandan farmers. Agricultural insurance is positioned among the strategies to promote access to agricultural credit to small-holder farmers in the face of enhancing farmers' adaptation to production and financial shocks arising from climate hazards of drought, floods, landslides, pests, diseases, parasites among others.

5.3 Agricultural Insurance in the climate change adaptation framework

Agricultural insurance is loosely mainstreamed in the climate change adaptation framework. Both the Climate change policy and the National Adaptation Framework for Agriculture do not explicitly emphasize agricultural insurance. The agricultural sector climate change adaptation priorities include; expanding extension services, climate-smart agriculture, livestock and crop enterprise diversification, value-addition, post-harvest handling and storage, access to markets and agricultural finance, rangeland management, research on climate resilient crops and livestock breeds and irrigation infrastructure (USAID, 2013; MWE, 2016; MAAIF, 2017). Notably, there is no explicit focus on

agricultural insurance and no interventions to this end. Climate Smart Agriculture which is a popular climate change adaptation program in the agricultural sector has neither integrated nor connected with agricultural insurance**.** One of the key informants had this to say in attest;

> *"I strongly believe that agricultural insurance has not gotten the attention it deserves in the climate change adaptation framework. Much of the emphasis is on promoting climate-smart agriculture. The strategies laid one in climate change adaptation policy do not explicitly address agricultural insurance" (KII6, July 2022)*

The Uganda Agriculture Insurance Scheme (UAIS) which is the main government program promoting agricultural insurance has structural constraints which undermine its effective linkage with farmers. This is in view of the key informants interviewed. The scheme is aligned with the Agriculture Finance Policy through which the Government of Uganda positions to scale-up agricultural insurance. The scheme was launched in 2017 by the Government of Uganda through the MoFPED in partnership with private insurance companies under their umbrella and Uganda Insurers Association (UIA). The Agro Consortium is another private partner taking lead in implementing the scheme through, a coalition of currently 13 insurance companies licensed to underwrite agriculture insurance in Uganda. The scheme is managed by a national steering committee comprising of MAAIF, UNFFE, UCA, Feed the Future, UNMA, UBA and Agribusiness alliance (MOFPED, 2017). It targets to cover small-scale farmers as individuals or groups dealing in the production of crops and livestock (MOFPED, 2017). Under the scheme, the Government allocated an initial UGX 5 billion (US$1.4 million) to subsidize agricultural insurance for farmers at 30-80 percent of the cost of premiums depending on farm scale and location. By 2020, the UAIS had sold out 225,000 policies compared with 25,000 in 2017 (MOFPED, 2017). As of June 2021, Government had increased the budget allocation to support agricultural insurance scheme to 10 billion UGX and reached a total of 375,640 farmers. The funding is allocated for awareness creation, payment of insurance subsidies as well as implementation and management of the Agricultural Insurance Scheme (MOFPED, 2021).

The scheme intends to render agricultural insurance affordable to smallholder farmers and ultimately enhance farmers' access to credit. The scheme offers premium subsidies to a range of crop, livestock, poultry, and aquaculture insurance cover. The insurance policies cover a broad range of farms from small rural acreages to traditional production farms and the largest commercial-oriented farms (MOFPED, 2017). Drought Weather Index Insurance (WII) and the Area Yield Index Insurance (AYII) remain the most popular insurance products respectively under the scheme. The scheme provides a premium rate of 2.75% of the expected yield/loan/amount insured in non-high-risk areas (Net of the 50% Government premium subsidy), 10% in disaster-prone areas, and 5.5% for all other districts. Approximately 65 percent of policies are underwritten and 90 percent of the premium are for multiple peril crop insurance. This product has an average premium of UGX 180,000 (US$48), which is unaffordable for smallholders implying that it is mainly demanded by medium larger scale commercial farmers. Claims are automatically paid out at the end of the crop season (MOFPED, 2017)

Farmers access the scheme through an online application process. Application forms are downloaded and filled out online. The applications are sent by email to the Agro-insurance Consortium (AIC). The AIC appoints a verified technical person to assess the general condition of the farm (crops/livestock) and makes the recommendation for the general farm condition and the report communicated to the farmer. The AIC sends a quotation to the farmer based on the values proposed. The value of crops or livestock to be insured is mutually agreed upon after the assessment. In case of over/ under insurance as per quoted premium, the farmer is advised accordingly, following which a policy is issued. An officer returns periodically to assess the farm through the season. The insurer collects the premium from the farmer who may also pay it directly to AIC. The government pays part of farmers' insurance premiums. Notably, monitoring for optimal growing conditions is done via satellite throughout the season to detect any deviations from historical averages that would adversely affect yield production. Yield losses are based on drought severity in an area. Insured farmers are automatically compensated to the extent of the average loss suffered by all farmers in the locality (MOFPED, 2017).

Lastly, we observed that agricultural insurance and its supporting insurance scheme remain disconnected from the mainstream agricultural extension system at district and local government levels yet these are key government structures for delivery of services to farmers under the decentralized service delivery framework in Uganda. Although a bigger subsidy is extended to farmers in high-risk areas specifically those more prone to climate change hazards; interventions to popularize the scheme remain limited in these areas. Hence, the majority of farmers are unable not only to access the support under the agricultural insurance scheme but also agricultural insurance in general due to the prevailing demand side barriers. The planning and budgeting framework at District and Sub-county levels of local governance through the offices of agriculture, environment, and natural resource management are yet to integrate agricultural insurance within the framework of climate change adaptation. The link between these offices and the national-level agricultural insurance promotion structures and programs remains is very weak or inexistent at all. There are barely any programs to promote agricultural insurance from the supply and demand perspectives at the local level structures of service delivery. The Agro-consortium, a private entity contracted by the government to extend the insurance subsidy to farmers is limited in outreach largely due to budget or resource constraints. To affirm these gaps from the researchers' critical view of the key informants' views and insights from document reviews, one of the key informants had this to say;

> *"The agricultural insurance scheme is a significant step towards promoting agricultural insurance. However, I have strong reservations about how its delivery is structured. MAAIF has no leading role in its implementation and it remains disconnected from the mainstream agricultural extension system. This has created inefficiencies in reaching the grass root farmers and popularizing it among the local level stakeholders" (KI7, August, 20122).*

5.4 Summary

The chapter has identified the weak links and rationalized the need to mainstream agricultural insurance in the climate change adaptation framework given its potential significance to the realization of national development aspirations. From a critical analysis of the institutional framework for climate change adaptation it is observed that, agricultural insurance is quite relevant to Uganda's development framework at the National and sectoral levels. Secondly, agricultural insurance is however loosely mainstreamed in the climate change adaptation framework. Both the Climate Change Policy and the National Adaptation Framework for Agriculture do not explicitly emphasize agricultural insurance. Thirdly, the agricultural insurance scheme holds huge potential to promote agricultural insurance as a climate change adaptation strategy. However, management and implementation of the scheme faces structural and financial capacity constraints.

CHAPTER SIX

DETERMINANTS OF FARMERS' ADOPTION OF AGRICULTURAL INSURANCE: EMPIRICAL DATA FROM FARMERS IN BUDUDA DISTRICT

This chapter presents empirical findings on determinants of farmers' adoption of agricultural insurance deriving facts from empirical data from farmers in Bududa district. Before delving into agricultural insurance determinants, I first highlight on the climate risks and conventional adaptation mechanisms to try and position agricultural insurance within the broader framework for climate change adaptation in the farming context. I specifically provide a descriptive analysis of climate risk and adaptation strategies as well as the extent of their adoption of agricultural insurance. The former is intended to locate the farmers' specific context of climate change adaptation within which the adoption of agricultural insurance is analyzed. The latter ascertains the distribution in responses for the adoption categories which was critical to inform the possibility of advancing to the inferential analysis and to test the hypotheses regarding the determinants for adoption. The inferential analysis of determinants for the adoption of agricultural insurance is then presented focusing categorically on; the characteristics of the farmer and the farm. This analysis largely applies chi-square tests of significance in proportions of the different variable categories between farmers who adopted and those who had not adopted agricultural insurance.

The inferential analysis finally estimated a logistic regression model to predict the significance and magnitude of the effect of the variables which were hypothesized to affect the adoption of agricultural insurance in this study. Leveraging on the key lessons from the empirical analysis of the determinants for the uptake of agricultural insurance, a conceptual model was derived which can guide interventions to promote adoption of agricultural insurance in a climate risk context. The chapter ends with a discussion of the emerging empirical findings on the determinants for farmers' adoption of agricultural insurance.

6.1 Descriptive analysis of climate risk, adaptation strategies, and adoption of agricultural insurance

This section is divided into two sub-sections; (i) a descriptive analysis of climate risk and adaptation strategies and (ii) a descriptive analysis of farmers' adoption of agricultural insurance. The former is intended to locate the farmers' specific context of climate change adaptation within which the adoption of agricultural insurance is analyzed. The latter ascertain the distribution in responses for the adoption categories which was critical to inform the possibility of advancing to the inferential analysis and to test the hypotheses regarding the determinants for adoption.

6.1.1 Climate risks and conventional adaptation mechanisms among farmers in Bududa district

To understand the climate risk problem in the study sites, the analysis generated the percentage distributions of farmers' opinion on occurrence of climate risks of floods, droughts and landslides in terms of frequency and intensity. In addition, the percentage distribution of their opinion on adaptation mechanisms or measures were generated. Results are presented in table 6.1

Table 6.1: Percentage distribution of farmers by exposure to climate risk and adaptation strategies

Variable	Categories	Percentage of respondents
Climate risks	Floods	65%
	Drought	20%
	Landslides	15%
Frequency of occurrence-floods & slides	Rarely occur	13%
	Frequent	45%
	Very frequent	42%
Intensity of climate risks	Mild	5%
	Intensive	4%
	Very intensive	91%
Main adaptation measures	Use resistant varieties	70%
	Adjust planting dates	7%
	Rely on government relief	22%

Source: Statistical estimates from field survey data on farmers

Floods and drought were the two major climate risks faced by farmers. This is consistent with the World Bank Report which identifies the North Eastern region of Uganda and the South Eastern Uganda to be the most affected by water scarcity. The North Eastern Region where Bududa lies receives an overall monthly average maximum temperature of 29^{o}C (Word Bank, 2019[i]). Their occurrence was considered to be very intensive as indicated by 91% of the respondents. Floods and landslides for example were reported to occur averagely seven once in a year for the majority (87%) of farmers. These extreme weather events were associated with huge production losses in terms of yield and quality of produce which undermined farm income and posed a serious food security threat. As a means of adaptation, the majority (70%) of farmers reported using crop varieties that can withstand drought and other extreme weather events. In addition, some farmers adjusted planting dates. A detailed engagement with farmers through Focus Group Discussions revealed that although they preferred to use resistant varieties, they were costly to buy and financial institutions were reluctant to extend them credit for the purchase of the improved seeds. Besides, the market for the so-called improved breeds were distorted by counterfeits. Consistently, key informant interviews generally affirmed the climate risk problem in Bududa and identified the conventional copying mechanism as the most dominant means of adaptation. One of the farmers' leaders had this to say;

> *"Climate risks are a reality here in Uganda and worse in Bududa district, an area which has consistently been hit with floods, landslides, and drought. They are very intensive when they occur. We rely on farming as a means of livelihood. We are issued with early warning and advised to prepare. The best option would be to live in this area and try farming elsewhere but this is our motherland. We have nowhere else to go. We suffer big losses but have no option. Our crops are swept away and houses destroyed year after year "(KI9, August 2022)*

In an event of occurrence of a climate shock, many of the farmers rely on social safety nets or disaster relief programs by Government, International Development Agencies mainly; World Food programme and Red cross as well as Civil Society Organizations. To a minimal extent, farmers rely on social networks where they borrow some money from friends and relatives as well as Saving and Credit Associations to absorb the financial shocks. Further engagement with the leaders of farmer groups revealed generally that while social ties would be ideal source of financial and none-financial support to cope with the financial shocks, they were constrained by low income and asset levels among the individuals and groups within the farmers' social networks.

6.1.2 Farmers' adoption of agricultural insurance: A descriptive analysis

To understand the extent of adoption of AI which would open insight into the possibility of inferential analysis to test the determinants of adoption, the analysis generated percentage distribution of respondents on adoption of agricultural insurance as indicated in figure 6.1

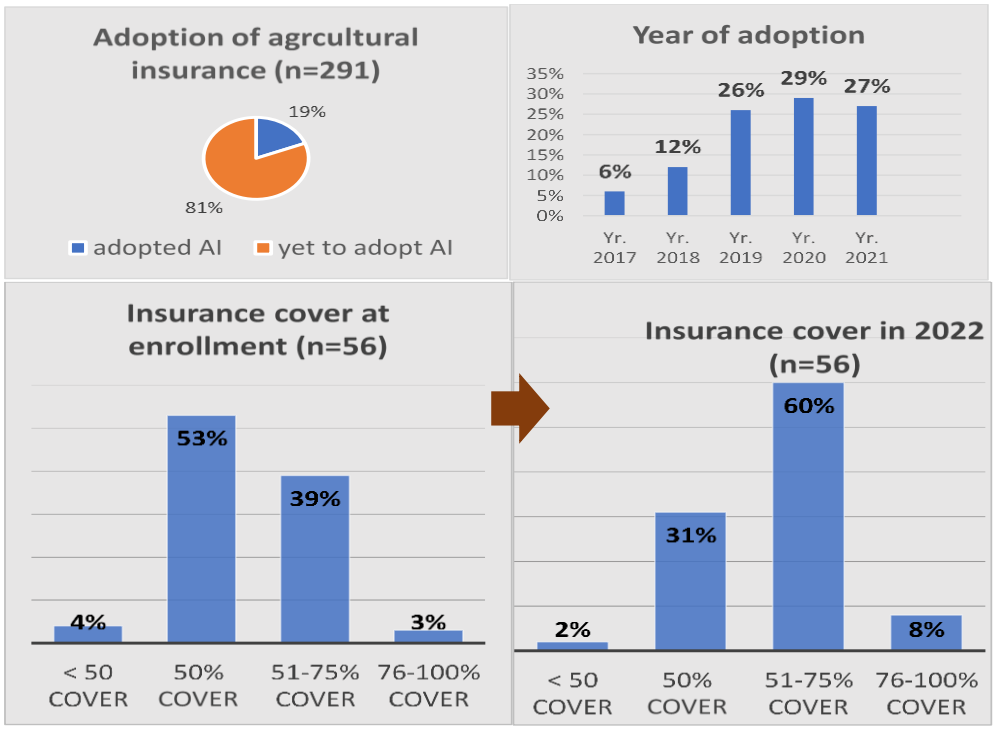


Figure 6.1: Adoption of agricultural insurance among small holder farmers in Bududa district

The majority (81%) of farmers had not taken up or adopted agricultural insurance covering an average of 2.4 hectares. The majority (54%) of the farmers who adopted had enrolled for agricultural insurance between the period 2020 and 2021, approximately 3-4 years after the roll-out of the agricultural insurance scheme. These first-time users indicated to have bought insurance premiums averaging at UGX 57,878 per farmer. At enrollment, the majority (53%) of the farmers who had adopted had insured not more than 50% of their crop fields while 39% insured 51-75% of their crop fields. As of 2022, the insurance coverage had increased with the majority (60%) of farmers who had adopted reported to have insured more than half of their crop fields. 18% reported having dropped out mainly on account that the insurance was not making economic sense to them coupled with delayed payments. Consistently. key informant interviews revealed that although farmers are gradually taking up agricultural insurance, the pace is still too long particularly among smallholder farmers not only in Bududa district but also in other districts country-wide. In attest, one of the key informants had this to say;

> *"Adoption of agricultural insurance is indeed very low particularly among smallholder farmers despite the increasing trend of adoption in the last three years. This is also the case in areas at high risk of climate change including Bududa district. The fact is that agricultural insurance remains dominant among large-scale farmers in the central and western regions of Uganda. These are typically commercial farmers" (KI7, August 2022)*

6.2 Determinants of uptake of agricultural insurance: Demand side factors

From the empirical, conceptual, and theoretical perspectives presented in the previous chapter, the study hypothesized that the uptake of agricultural insurance from the demand side perspective would depend on; the characteristics of farmers and their farms. The former was analyzed in three dimensions, that is; (i) farmers' socio-economic characteristics operationalized into sex and age, education level, household size, and income; (ii) farmers' level of organization and household liquidity operationalized into ownership of a bank account and savings, membership to farmer group and level of income diversification; (iii) farmers' knowledge and perceptions about agricultural insurance Regarding farm characteristics, the effect of farm purpose, farm size, and farm modernization or capital investment was analyzed. This section, therefore, presents findings from inferential analysis regarding the effect of these factors on the uptake of agricultural insurance.

The section is divided into two detailed sub-sections; one focusing on the farmer characteristic and the other on farm characteristics. The analysis utilized Chi-square tests of significance in difference between proportions of farmers who adopted and those who had not adopted agricultural insurance by the farmers and farm characteristics The analysis further estimated a logistic regression model to predict the significance and magnitude of the effect of the farmers and farm characteristics which were hypothesized to affect the adoption of agricultural insurance in this study. Finally, leveraging on the key lessons from the empirical analysis of the determinants for the uptake of agricultural insurance, I derive an econometric model and frame a conceptual model which can guide interventions to promote adoption of agricultural insurance in a climate risk context.

6.2.1 Effect of farmers' characteristics on adoption of agricultural insurance

This sub-section presents survey findings in line with the objective on the determinants for farmers' adoption of agricultural insurance and with reference to the effect of farmers' characteristics from the demand side perspective. Recall, the analysis of farmers' characteristics on adoption of agricultural insurance took two dimensions i.e; the effect of farmers' socio-economic characteristics and the effect of farmers' access to training, knowledge and perceptions about agricultural insurance. Findings are presented in sub-sections 6.3.1.1 and 6.3.1.2

6.2.1.1 The effect of socio-economic characteristics

The analysis provides a statistical characterization of farmers' adoption of agricultural insurance by the magnitude of risk sex, age, education level, and group membership. It was assumed that these socio-economic characteristics would affect the adoption of agricultural insurance through their mediating effect on access to training. Hence the training variable was integrated into the analysis by way of path analysis towards confirming the effect of the socio-economic variables. The analysis utilized chi-square tests for the significance of proportions for which results are presented in **Table 6.2**

Table 6.2: Characterization of farmers' adoption of agricultural insurance by socio-economic characteristic

Variable		Training			Adoption		
		Trained	Never trained	$\chi 2$ (p)	Adopted	Yet to adopt	$\chi 2$ (p)
Sex	Female (n=175)	25%	75%	13.07* (0.00)	14%	86%	26.78* (0.00)
	Male (n=114)	46%	54%		32%	68%	
Age	18-35 years (n=80)	68%	32%	0.008 (0.52)	11%	89%	5.23* (0.018)
	36 and above (n=211)	67%	33%		24%	76%	
Education	Primary or secondary (n=86)	58%	42%	8.61* (.035)	28%	72%	2.39 (0.06)
	Tertiary or university (n=199)	69%	31%		19%	81%	
Group membership	Farmer group member	77%	23%	62.1* (0.00)	31%	69%	38.03* (0.00)
	None member	16%	84%		18%	82%	
AI training	Trained				27%	73%	61.48* (0.000)
	Never trained				18%	82%	

** Difference in proportions statistically significant at 5% significance level*
Source: Estimates from field survey data on farmers

Results revealed a significant gender difference in adoption of agricultural insurance. 14% of the female farmers had adopted agricultural insurance compared with 32% of the male farmers who had adopted. Hence, female farmers were less likely to adopt agricultural insurance than male farmers. Consistently, the majority (46%) of male had accessed agricultural insurance training which was higher than the proportion (25%) of female farmers which had accessed training. Moreover, 27% of the farmers who had adopted agricultural insurance had accessed training on agricultural insurance significantly higher than the 18% of the farmers who had not accessed training but adopted agricultural insurance.

Regarding age, 11% of the youth had adopted agricultural insurance, a proportion which was significantly lower than that of the aging and aged group of farmers (24%) who had adopted agricultural insurance. This means the youth were less likely to adopt agricultural insurance which was consistent with the set hypothesis. Notably, the difference in the adoption of agricultural insurance between the two age groups could not be attributed to training access as earlier hypothesized as there was no age difference in access to trainings. But rather, the difference can be explained by the difference in risk averseness between young the older farmers. Specifically, older farmers were more likely to adopt because of being more risk averse. To affirm the sex and age differences in the uptake of agricultural insurance, one of the key informants and this to say;

> *"Although uptake of agricultural insurance is generally low. There are noticeable sex and age differences. We have more men subscribing to agricultural insurance than women which is mainly because they access trainings more than women. Men culturally are more mobile and by virtue of their position as household heads, are expected to attend most community meetings or trainings as women undertake home chores. Adoption is lower among youth age group than their counterpart. Many of the insurance subscribers are old people. This is because this age group is more risk averse and more engaged in farming than the youth" (KI9, August 2022)*

Regarding level of farmer organization, a significant difference was observed in adoption of agricultural insurance between farmers who belonged to a farmer or savings group and those who never belonged to a group. Specifically, 31% of the farmers who belonged to a farming group had adopted agricultural insurance. This proportion was significantly higher than the (18%) of farmers who had adopted agricultural insurance not belonging to any farmer group. Hence, organizing farmers was more likely to foster adoption of agricultural insurance. This finding on one hand is attributed to increased chances of accessing training on agricultural insurance among farmer group members. On the other hand, Farmer group membership had a positive implication to financial literacy. Farmers are more likely to have a savings account when they belong to a farmer group. Arguably, saving is a principle for many farmer groups and is part of the training programs for farmer groups which builds farmers' positive mind set towards formal savings mechanisms and having a savings account. The savings account and access to financial services means that farmers have an opportunity to learn agricultural insurance through their interaction with financial service providers and hence more likely to embrace agricultural insurance. On the other hand,

belonging to a farmer group was perceived an opportunity for accessing financial support from a group to be able invest in agricultural insurance in view of the income constraints they face. To affirm the significance of groups membership or farmer organization to adoption of agricultural insurance, one of the key informants had this to say;

> *"In the context of our farming community and structure of agricultural support programs, there is a tendency to target farmers in groups. They are easy less costly to mobilize. Besides, the impact of any interventions is quickly felt when farmers are reached in groups. This is also the case for agricultural insurance where its promoters target organized farmers who are mobilized through their leaders. Hence are more likely to received knowledge about agricultural insurance and therefore adopt unlike the individual farmers" KI10, August 2022)*

Statistical evidence was generated on the effect of household income vulnerability reflected by the magnitude of risk exposure and ease of absorbing financial shocks and operationalized by ownership of a bank account/savings. To test this hypothesis, the chi-square test results for significance in proportions between farmers who adopted agricultural insurance and those who never adopted across these farm characteristics – level of climate risk exposure and ownership of a bank account & savings **(Table 6.3)**. Notably, the effect of income diversification was not tested since the data did not have sufficient representation of farmers who had diversified income sources. In fact, the majority (92%) of farmers in the survey sample depended solely on farming and specifically crop production as a source of livelihood.

Table 6.3 Correlation between farmers' climate change and income vulnerability and on adoption of AI

Variable	Categories	Adopted	Yet to adopt	$\chi 2$ & p-value
Level of risk exposure	Mild (n=15)	15%	75%	1.52 (0.466)
	Intensive (n=302)	13%	77%	
Ownership of bank account & savings (risk vulnerability)	Bank account and savings (n=71)	29%	71%	98.53* (0.00)
	No account & savings (n=217)	12%	88%	

** Difference in proportions statistically significant at 5% significance level*
Source: Estimates from field survey data on farmers.

The majority (77% and 75%) of farmers had not adopted agricultural insurance with no significant difference across level of risk exposure Notably, the analysis of risk exposure took into account only farmers who experienced floods and landslides due to lack of no sufficient variation in the data on the severity or occurrence of drought. Although floods and landslides affect farmers at varying intensity between the steep slopes and the low land areas, the data could not have sufficient cases of farmers who were faced by theses climate risks at varying intensity. As a means of capacity to absorb financial shock when climate disaster strikes, only 29% of the farmers who had a savings account and savings had adopted agricultural insurance significantly more than those who had adopted with no account and savings (12%). Overall, 24.7% of the farmers had a bank account and savings. This implies farmers are more likely to adopt agricultural insurance if they have a bank account and savings. This can be attributed to financial literacy which is associated with trust in financial services and hence willingness to adopt agricultural insurance. This however contrary to the hypothesis that such farmers are less likely to adapt due to their liquidity nature which can enable them easily absorb a financial shock. Key informant interviews generally revealed that farmers owning a bank account was associated with financial literacy and hence more likely to trust agricultural insurance services and therefore. One of the key informants had this to say in attest.

> *"When you analyze critically the application data of farmers, we have sold insurance premiums to, you will realize that majority of them owned a bank account at the time of application and were actively saving. The more farmer interacts with financial service providers, the more they get to trust financial services" (KI11, August 2022).*

6.2.1.2 The effect of farmers' perceptions, knowledge & training access on the adoption of agricultural insurance

One key knowledge thread arising from an analysis of the gender implications to training access and uptake of agricultural insurance is the fact that; adoption of agricultural insurance significantly varies by sex and level of farmer organization. This is because of the significant differences in access to training across these variables. It implies that the gender differences in the uptake of agricultural insurance mainly arise from the differences in access to training advancing the hypothesis that "training significantly affects the uptake of agricultural insurance". This hypothesis was tested in this sub-section using correlation

analysis. The underlying assumption is that; training is significantly and positively correlated with agricultural insurance knowledge, attitude/perceptions and ultimately adoption of agricultural insurance as indicated in

Table 6.4**:** Correlation results: Relationship between AI training, knowledge, perceptions and adoption

Variables	**Training on AI**	Knowledge about AI	Perception-relevance of AI	Perception-affordability of AI	**AI adoption**
Training on AI		0.607**			**0.733**
Knowledge about AI			0.593**		
Perception- relevance of AI				0.597**	
Perception-affordability of AI					0.734**
Perception- economic value of AI	**0.484****				**0.580****

***Correlation is significant at 5% significant level (2-tailed)*
Source: Estimates from field survey data on farmers

Training had a significant and strong positive relationship with farmers' knowledge about agricultural insurance (r=0.607**) as well as insurance uptake (0.733). This implied that farmers who accessed training on agricultural insurance were more knowledgeable about it than those who never accessed the training. Notably, the correlation coefficients indicated that farmers' knowledge of agricultural insurance was significantly and positively correlated with their perceptions about agricultural insurance in terms of its relevance/importance (0.593**) as well as its affordability (r=0.597**). Training and knowledge on agricultural insurance were also positively associated with a positive perception regarding the economic value of agricultural insurance (r=0.580**). In other words, farmers who were trained and knowledgeable about agricultural insurance perceived agricultural insurance to make economic sense which subsequently enhance its uptake (r=0.484**).

These findings confirm the guiding hypothesis and attest that farmers trained and knowledgeable about climate change risk and agricultural insurance can appreciate the insurance premium charged by the insurers. They take into account the government subsidy, consider the loss that would be encountered when disaster strikes with no

insurance and hence choose to enroll for agricultural insurance. On the other hand, insurance-ignorant farmers find it difficult to understand and appreciate the economic value of agricultural insurance. Additionally, knowledge of climate risk and agricultural insurance enables farmers to be more risk averse, trust the agricultural insurance facility and hence adopt it. The analysis further painted a picture of the percentage distributions of farmers by access to AI training, knowledge, and perceptions **(Figure 6.2).**

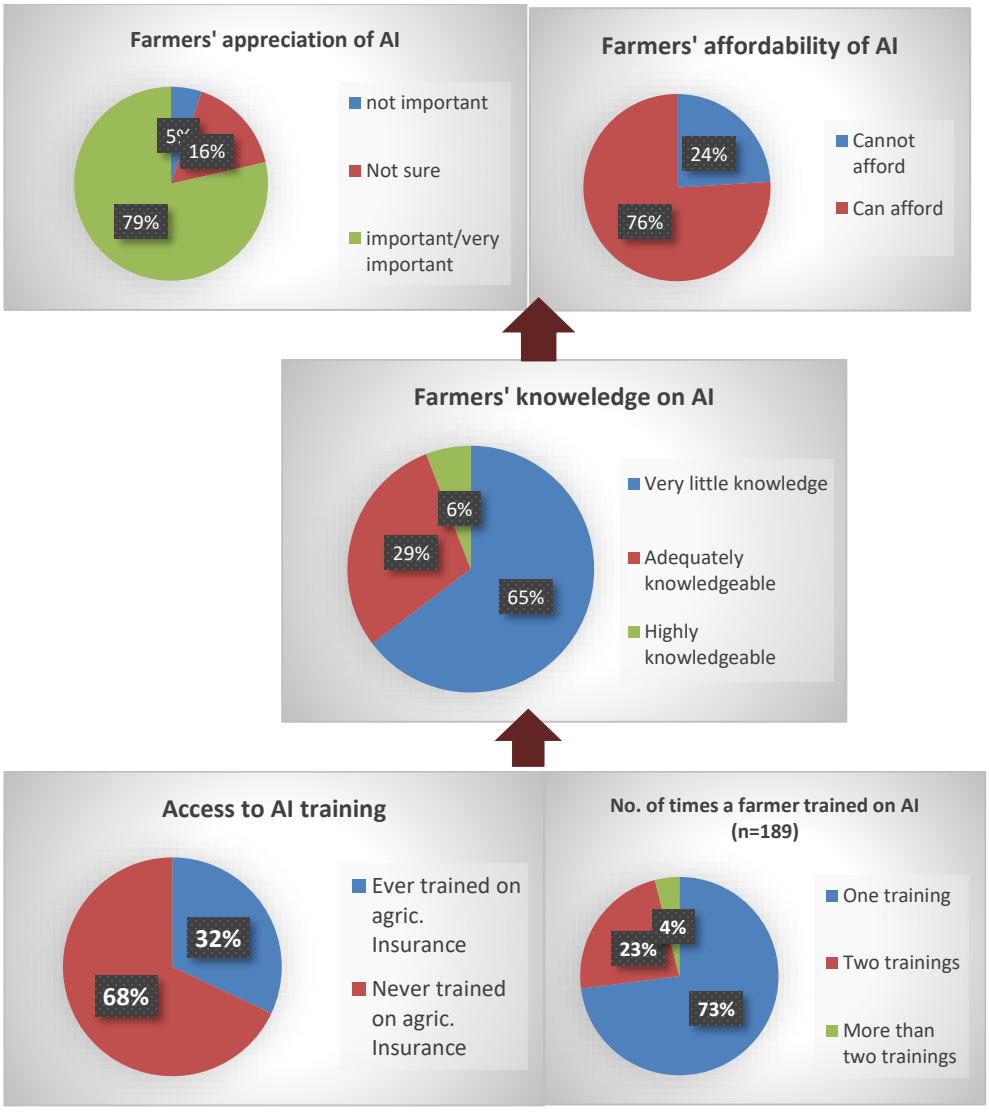


Figure 6.2: Percentage distributions of farmers by access to AI training, knowledge & perceptions
Source: Estimates from field survey data on farmers

The majority (68%) of farmers had not accessed training on agricultural insurance. Specifically, farmers reported to have received orientation on the concept of agricultural insurance covering its importance, the products and insurance premiums, the providers of insurance services, the role of Government and the Agro-consortium, the insurance premiums, application process and payment terms. This training is mainly provided by the Agro-consortium, a private company contracted by the Government of Uganda to manage the agricultural insurance scheme and scale up uptake of agricultural insurance. The company organizes trainings in specific localities targeting farmer leaders who are expected to train farmers in their respective groups. For the 36% of the farmers who had accessed training, their frequency of training access as well as their insurance knowekedge, appreciation and perceptions were analyzed. However, the majority (73%) of farmers indicated to have accessed training on agricultural insurance only once which seemed inadequate to grasp the complex package of agricultural insurance in terms of its design and processes involving, application, assessment of premiums as well as payment of compensations. To a great extent, the low intensity of training is consistent with the fact that the majority (69%) of farmers had very little knowledge on agricultural insurance.

> *"As a leader of farmers, I can confidently say that most farmers do not know about agricultural insurance because they have not had an opportunity to be trained. Personally, I have only been trained once. It was just a brief introduction about agricultural insurance and its benefits and how it works. I could not of course learn much and I can't say much about it. From what I learnt, agricultural insurance is good way of managing risks and losses in farming although I cannot explain well to my fellow farmers" (KI12, August, 2022).*

A detailed engagement with the management of the Agro-consortium which largely the sole private company undertaking capacity building for uptake of agricultural insurance in the farming communities in Uganda revealed that; despite the company's efforts to sensitize the farming communities about agricultural insurance and encourage them to insure their farms by taking advantage of the insurance subsidy provided by government, scaling up the trainings remain limited by capacity challenges. Specifically, the company's budget is too small to increase staffing and finance sensitization and training activities across the country. Further attest to the limited capacity of the Agro-consortium can be derived from the sentiment below.

"As a consortium we have a long way to go to promote agricultural insurance. Our major focus in on creating farmers' awareness. We target local leaders, technocrats and farmer leaders. On rare occasions, we reach some farmers although it is very hard to reach individual farmers wherever we go. We are thin on ground because of limited financial capacity. It is very costly to finance field trips and out operation budget is very small. The biggest budget we get from the MOFPED caters for insurance subsidy. The annual budget has been 5 billion Uganda Shillings over the last 4 years which is a drop in an ocean considering the approximately 3.5 million farmers who need agricultural insurance" (KII3, August 2022)

Notably, the training and knowledge on agricultural insurance were associated with positive effects on farmers' perceptions about agricultural insurance particularly with regard to its importance and affordability. Farmers' learning about agricultural insurance and how it works meant that the training enables them to build a positive mind set about it. They are able to appreciate that with the insurance cover, one is perceived less risky to lend and therefore attract credit from financial institutions. Besides, they are able to appreciate the fact that; agricultural insurance safeguards or secures their farm income thereby guaranteeing them earning whether or not disaster strikes amidst the climate change risk. Learning about agricultural insurance also mean that farmers are able to see insurance as an affordable investment. Insurance knowledge clears the common illusions about insurance as an investment for the rich. The trainings are also able to demonstrate the magnitude of loss a farmer can circumvent by buying an insurance premium which is already subsidized by government. Farmers are made aware of how the cost of insurance and how it can get even much cheaper and affordable if they choose to apply for insurance premiums as a group, also known as "group cover". The significance of the trainings to adoption of agricultural insurance was affirmed by many key informants of whom one had this to say;

"Although we are yet to reach a significant number of famers, the few we have reached appreciate agricultural insurance. A good proportion of those we sensitize end up buying the insurance premiums. You see, the key point here is changing the mid set of the people about agricultural insurance. When people here of it they think it is for the reach. They think it is not affordable. They lack a clear understanding of how it can benefit them. Our sensitizations and trainings go a long way to address these knowledge gaps. The fact is that agricultural insurance is a way to go. It is our task to make farmers appreciate it" (KII2, August, 2022).

6.2.2 Characterization of farmers who adopted agricultural insurance by farm characteristics

The nature of farming system in terms of farming purpose, capital investment as well as use of modern technologies and hired labor was analyzed. Theoretically, these operational dimensions of farm structure were hypothesized to bear a significant positive effect on adoption of agricultural insurance. Presumably, these attributes of the farm position its economic significance hence determine the level of risk consciousness and willingness to adopt agricultural insurance. To test this hypothesis, the Chi-square test results for significance in proportions between farmers who adopted agricultural insurance and those who never adopted across these farm characteristics are presented in **Table 6.5**

Table 6.5: Characterization of farmers who adopted agricultural insurance by farm characteristics

Variable	Categories	Adopted	Yet to adopt	$\chi 2$ & p-value
Farming technologies	modern technology (n=172)	24%	76%	39.63* (0.00)
	Tradition/conventional (n=115)	12%	88%	
Hire labor	Yes (n=104)	34%	66%	28.19* (0.00)
	No (n=179)	26%	74%	
Farm purpose	Semi-commercial (n=49)	29%	71%	39.6* (0.00)
	Subsistence (n=216)	10%	90%	

**Difference in proportions statistically significant at 5% significance level*
Source: Estimates from field survey data on farmers

The majority (29%) of the farmers who pursued farming partly or entirely on a commercial basis adopted agricultural insurance, a proportion which is significantly higher than the (10%) of the farmers who engaged in purely subsistence farming and adopted agricultural insurance. Similarly, the majority (24%) of farmers who used modern farming technologies had adopted agricultural insurance, a proportion that was significantly higher than the 12% of farmers who used traditional/conventional farming technologies and adopted agricultural insurance. In addition, the majority (34%) of farmers reported using hired labor had adopted agricultural insurance, a proportion significantly higher than 26% of the farmers who had adopted agricultural insurance without using hired labor. Hence, farmers who pursued farming as a business (used hired labor, and (or) modern farming technologies such as

improved seed, fertilizers, and machinery) were more likely to adopt agricultural insurance than those whose farming was subsistence and never such technologies.

Hence findings agreed with the guiding hypotheses and attested that the economic significance of the farm enterprises is significantly associated with adoption of agricultural insurance in the context of the farming communities. This is because such a farming structure is associated with high capital investments which sometimes is borrowed, hence increased consciousness about losses in case of climate shocks. Hence such farmers are more conscious about enrolling for agricultural for security of their farm income and ability to recoup capital invested in case of any climate shock. Besides, such farms with a high level of capital investment are financed mainly by credit for which financial institutions demand mandatory insurance cover. Notably, the descriptive analysis revealed that the majority (81.5%) of farmers pursued a commercial production goal alongside the substance objectives and were using capital investments in terms of modern farming technologies (60%) and hired labor (36.7%). This farm structure and considering other factors like; the high risk of exposure to climate shocks and the low uptake of agricultural insurance presents a high risk to farming in this context. On the other hand, it underscores the relevance of and great potential for the uptake of agricultural insurance. Consistent with this argument, one of the key informants had this to say;

> *"Agricultural insurance is mainly adopted by commercial-oriented farmers. This is because, unlike for subsistence farmers, the cost involved in buying the insurance premiums and the consciousness about farm profitability have put in some considerable level of capital investment. Besides, commercial farmers desperately need credit to invest in their farming business which they can easily acquire with insurance as a pre-requisite for many financial institutions. Notably, most farmers are pursuing a commercial objective which puts them at a high risk of loss and can be an opportunity to adopt agricultural insurance." (KII3, August 2022*

6.2.3 Logistic Regression model: Determinants of agricultural insurance uptake

For further analysis of the drivers of insurance uptake, a multiple regression model was fitted with variables operationalizing the characteristics of the farmers and the farm earlier hypothesized. Farm characteristics were represented by farm purpose operationalizing the effect of the economic significance of the farm. In addition, the effect of farmer access to training was tested in the regression model which was significantly related to the perception

of relevance, importance and quality of agricultural insurance. In addition, membership to the farmer group and affordability of agricultural insurance were included in the regression model. Notably. the effect of farmer characteristics specifically; gender (sex & age) were not tested in the regression model although they were significantly associated with the adoption of agricultural insurance. This is because they were highly and positively correlated with training access and farm purpose which were already significant in the regression model.

The effect of farmers' climate and household income vulnerability defined by farmers' liquidity and potential for absorbing financial shock was not tested in the regression model for two reasons. First, ownership of a bank account and savings which had indicated a significant association or relationship with the adoption of agricultural insurance was highly correlated with membership to farmer group, training and perception of insurance affordability which had already fit well in the model. Secondly, the dimension of farm income diversification could not be analyzed due to insufficient cases of farmers with diversified income sources. Similarly, the effect of magnitude of climate risk exposure was not tested in the regression model as preliminary analysis indicated its insignificant association with the adoption of agricultural insurance. Regarding farm characteristics, farm size and level of capital investment were excluded from the model because they were highly correlated with farm production purpose which notably turned out highly significant in the model. Moreover, these were additional proxies for measuring the economic significance of the farm enterprise. Consequently, the final logit model which was fitted to predict the adoption of agricultural insurance is provided in **Table (6.6)**

Table 6.6: Binary logit model results for determinants of agricultural insurance uptake

Variables	B	S.E.	Wald	Df	Sig.	Exp(β)
Constant	3.246	.651	24.862	1	.000	.039
Trained in AI	1.121	.586	3.661	1	.050	3.068
Farm purpose	2.564	.542	22.379	1	.000	12.988
Affordability of AI	1.883	.561	11.258	1	.001	6.576
Membership to FG	1.948	.579	11.326	1	.001	7.015

-2Log likelihood=128.089; Cox & Snell R Square=352; Nagelkerke R Square=0.552

Source: Estimates from field survey data on farmers

The Nagelkerke R Square was 0.552 which in percentage terms implied that the variables fitted in the model accounted for 55.2% of farmers' uptake of agricultural insurance. The variables which were significant in explaining the uptake of agricultural insurance are; access to training (p=0.050), the purpose of farm enterprise or farm production purpose (p=0.000), perception of affordability of agricultural insurance (p=001), and membership to a farmer group (p=0.001). The positive sign of the beta-coefficient (β) for the effect of farmers' access to training on agricultural insurance was positive suggesting that farmers who had accessed training on agricultural insurance were more likely to adopt or buy insurance premiums than those who never received the training.

Farm purpose also had a positive coefficient implying that farmers who engaged in semi-commercial farming were more likely to adopt or buy insurance premiums than those who pursued farming for subsistence purpose. Regarding financial literacy which was measured by possession of a bank account, the positive sign of this coefficient implied that farmers who had a formal savings account with a financial institution were more likely to adopt or buy insurance premiums than those who had no bank account. Finally, farmers who perceived agricultural insurance as an affordable risk management facility were more likely to adopt or buy insurance premiums than those who never had such a positive perception toward agricultural insurance. The significance of the fitted logit model implies that farmers will more likely take up or adopt agricultural insurance when they; are organized in a group, perceive agricultural insurance as affordable, pursue a commercial farming objective and access training on agricultural insurance.

In terms of the magnitude of coefficients and as indicated by the β -coefficients, farming purpose had the highest effect (β=2.56), followed by membership to a farmer group (β=1.948), perception of affordability (β=1.88) and access to training (β=1.121) respectively. Regarding the probability of the effect, farmers who perceive agricultural insurance as affordable for investment, pursue a commercial farming objective, belong to a farmer group and access training had a 17.9% probability of adopting agricultural insurance. The 17.9% is computed as follows 1/[1+(sum (Xβ+α))] where; β=coefficients for the variables $X_1 \ldots X_n$ which is significant in the model; α=constant coefficient in the model

6.3 Discussion of empirical findings

The previous section established significant gender differences in the adoption of agricultural insurance for some reasons. Specifically, male farmers are more likely to adopt agricultural insurance because they are more likely to access training on agricultural insurance which bears significance to adoption. The youth farmers are less likely to take up agricultural insurance. The highly educated farmers who are more likely to access insurance information, easily understand the complex nature of agricultural insurance, and hence embrace such new technological innovations in their farming business. Another critical farmer characteristic concerns their level of organization. Farmers organized into formal groups will be more likely to adopt agricultural insurance since they are more likely to be knowledgeable about it through their higher probability of accessing trainings on agricultural insurance and informal social interactions.

Adoption in the context of this study was also observed to depend on access to training on agricultural insurance which was positively associated with farmers' knowledge and understanding of agricultural insurance, their perception of quality and relevance of agricultural insurance as well as their trust in the insurance providers. Farm characteristics have also been found to be Significant. Specifically, farms pursuing a commercial goal are more likely to adopt agricultural insurance since they are likely to be more risk-conscious given the economic significance of their farms and high capital investment. On the supply side, the quality of insurance and linkages with farmers have been observed to affect the demand for agricultural insurance. These factors are associated with the delivery cots and out-rich to farmers as well as their knowekedge and perception about agricultural insurance This current section provides a discussion of these empirical findings on these determinants for farmer adoption of agricultural insurance uptake in the study context. The discussion attempts to relate the key knowledge threads from the empirical findings with theoretical and empirical perspectives earlier presented in chapter 4. Using key insights from the qualitative views of key informants, the discussion expands the meaning and implications of the findings to adoption of agricultural insurance as a climate change adaptation strategy.

6.3.1 Farmers' characteristics and uptake of agricultural insurance

This section discusses findings on the effect of farmers' characteristics on uptake of agricultural insurance. From the inferential analyses presented in the previous section, agricultural insurance is observed to significantly depend on the interlinkages between; farmers' socio-economic characteristics, their level of organization, their access to training, knowledge and perceptions about agricultural insurance, their trust in the insurance facility and associated services providers. A discussion of the findings in line with the effect of these variables has been presented in sub-sections 6.3.1.1-6.3.1.3

6.3.1.1 Farmers' socio-economic characteristics

The findings of this study identified a positive significant effect of age on the adoption of agricultural insurance implying that older farmers were more likely to adopt agricultural insurance than the youth. This was linked with their higher level of risk averseness or consciousness than the youth. The significance of age in this study is consistent with the age effect observed in previous studies such as Kumari, Ahmad & Rajendra (2017)) in Nepal, Carrer et al. (2020) in Brazil, Aditya, Khan, Kishore (2018), Cariappa, et al. (2020 and India Bahrati et al. (2014).

The general observation from these studies is that older farmers were more likely to take up agricultural insurance than young farmers. In account, Mukhopadhyay et al. (2018) suggest that elderly farmers have more experience and hence more likely to employ agriculture insurance to mitigate climate risks. The effect of age observed in this study is however contrary to the findings by Swain& Hembram (2020) who observed farmers' age to be inversely related to the adoption of agricultural insurance on account that young farmers are more likely to be aware of the benefits of crop insurance. Nevertheless, the effect of age on the adoption of agricultural insurance remains an area for further empirical investigation to further validate the two schools of thought. Notably, the significance of age to the uptake of agricultural insurance suggests the need to mainstream gender in interventions promoting the uptake of agricultural insurance. Targeting youth is therefore quite paramount in the development of an insurance support program since the youth arguably hold the future of agriculture given the working population demographics of

Uganda where 68% of the working population is between 15-35 years (UBOS, 2020). This finding bear a significant implication on the design of insurance support programs with approaches which can attract the youth to adopt agricultural insurance

Although some educated farmers have reservations about insurance subscriptions, the study generally revealed a higher likeliness of subscribing to agricultural insurance among the highly educated farmers. This is consistent with the findings by Ankrah, et al. (2021) in Ghana where education was observed to facilitate the adoption process and shortens the lag phase in decision-making. Similar findings are reported by Bahrati et al. (2014) and Singh et al. (2017).in the context of the adoption of agricultural insurance in India. Further attest to the significance of education to the adoption of agricultural insurance draws from studies by Aditya, Khan & Kishore (2018) and Cariappa, et al. (2020) which observes that understanding crop insurance products requires a certain level of education. Similarly, interviews with insurance providers and managers in Uganda revealed that agricultural insurance is a complex matter that even with training, requires that farmers have at least general literacy and numeracy levels to easily grasp. On a positive note, the majority (80%) of farmers had attained at least a basic level of education (primary). This presents an opportunity for promoting agricultural insurance through farmer trainings since such farmers can be considered easily trainable.

6.3.1.2 Farmer's level of organization- Group membership

The empirical model revealed that the uptake of agricultural insurance depends on the characteristics of the farmers as well as the structure of their farms. Farmer characteristics include; age, sex, education level, household size, membership to farmer organization as well knowledge about agricultural insurance. The farm characteristics include; farm purpose, farm size, or level of capital investments. There are three lines of argument regarding the significance of group membership to the adoption of agricultural insurance. First, group membership was considered an opportunity for farmers to be able to attract support on new farming innovations, training, and financial services among others. Hence farmers organized in groups were more likely to be targeted by insurance service providers during the identification and delivery of the support interventions. Secondly, group membership was associated with decreased transaction costs of delivering agricultural

insurance like any other agricultural extension of support program as indicated in studies such as Decorn, Clark & Hill (2014),, GIZ (2021) and Kumar & Baljinder (2018), These studies generally observe that group insurance minimizes training costs, supervision and monitoring. The significance of group insurance is further underscored in a study by Deepa et al. (2020) which observes that groups or cooperatives can act as the service provider by making them formal insurance agents that can promote livestock insurance. Similarly, Mohammad et al. (2022) observed that farmers' group membership had a positive significant effect on willingness to pay for flood insurance as a climate change adaptation strategy in northern Bangladesh Similar findings are also reported by Ndagijimana (2020) from analysis of the effect of Villages Savings and Loan Associations on the adoption of index-based crop insurance.

Consistently, a discussion with the insurance providers revealed that; being a member of a farmers' group facilitates interaction and learning about agricultural insurance with a significant likeliness of affecting its uptake. Partly for this reason, the Agro-consortium, a private company implementing the agricultural insurance scheme in Uganda is promoting group insurance offering which exempts individual farmers from payment of insurance taxes hence subsidizing the insurance for a group cover. This is also in line with Uganda's agricultural extension system which leverages on farmer groups and cooperatives for efficient delivery of extension services. However, the main disadvantage of promoting group insurance was limited trust among the members as well as weak leadership in the groups. Consistently, findings by Bao et al. (2022) considers lack of trust between members and weak leadership that show sympathy when paying claims to members among the critical challenges to promoting group insurance.

Farmers' level of financial literacy

Findings revealed that farmers with savings account and actively saving will more likely adopt agricultural insurance. Possession of a bank account and saving is a key indicator of liquidity which is a key economic factor that has been observed to affect the uptake of agricultural insurance in previous studies such as Dey (2017) and Cole (2013). This is because savings is associated the with ability to afford paying for insurance premiums. This

is an indicator of financial literacy or inclusion which has been reported in other studies such as Cole et al. (2013) to bear a significant impact on the uptake of agricultural insurance. The general notion is that improving farmers' financial literacy is generally will improve demand for agricultural insurance.

On the other hand, impoverished households need to constantly save to accumulate money to buy agricultural insurance and lack of such savings, therefore, constrains farmers' ability to afford agricultural insurance. Possession of a bank account and savings among the majority (69%) of farmers earlier reported in this study can therefore be considered a critical factor as to why the majority of farmers regarded agricultural insurance as affordable despite their impoverished economic status. Farmers who don't save find their small farm income lost in many competing household needs that they lack the cash to pay for agricultural insurance. In addition, possession of a savings account and savings mean that farmers can easily attract credit from financial institutions hence standing a better chance of having cash to finance agricultural insurance. Moreover, interviews with financial services providers revealed that there is a growing interest in financial institutions to deal with insurance providers to extend credit to farmers towards finance agricultural insurance which is a huge potential to enhance the uptake of agricultural insurance. Lack of savings means that agricultural insurance will only be affordable to the wealthy farmers in Uganda, consistent with the observation by Mukhopadhyay, Madhabendra, & Partha (2019) and Swain & Hembram (2020).

6.3.1.3 Farmer's access to insurance training, their knowledge and perceptions

Training access is expected to address complex issues of insurance products and enhance farmers' willingness to adapt. It empowers farmers with knowledge and skills to understand and appreciate the quality of indices, insurance contracts, and purchasing and payment procedures of agricultural insurance hence building their adaptive capacity. Training, therefore helps farmers appreciate and develop positive attitudes towards and willingness to adopt agricultural insurance. The more training a farmer accesses the higher the likeliness of expanding their knowledge and taking up agricultural insurance and vice

The study findings revealed that training was associated with positive perceptions about agricultural insurance hence underscoring the effect of training on perceptions and uptake of agricultural insurance. Bahimati (2022) reported that increasing farmer awareness through various formal training programs can increase insurance purchasing by 5%. Similarly, Mohammad et al. (2022) observed that farmers' access to information through extension services created positive attitudes and willingness to pay for flood insurance as a climate change adaptation strategy in northern Bangladesh. Specifically, agricultural insurance was mainly perceived to be important in minimizing the risk of income loss associated with climate hazards hence giving farmers assurance of earning an income even in case a climate disaster strikes. Consequently, they are perceived to be income and food secure with agricultural insurance. These positive perceptions are consistent with findings from other studies for example, Bozzola & Finger (2021) and Afriyie-Kraft, Astrid & Damnyag (2020) in Ghana where 90% of cocoa farmers indicated that indexed-based insurance held merits for them.

However, there was a reported lack of knowledge of agricultural insurance among the farmers who had not been trained in agricultural insurance in the context of this study. Farmers did not view agricultural insurance as a means of assuring farm profits. This is because they did not know how exactly it can safeguard their potential income. Some farmers had a feeling that agricultural insurance is a public good and therefore the government needed to provide it at no any cost to the farmer. They felt agricultural insurance should be part of the mainstream agricultural extension services which they access at no cost. Many farmers also felt like the insurance providers should be able to return the premium payments in case a climate shock did not occur. In that case, they seemed not to understand the concept of agricultural insurance. Such lack of knowledge and understanding of agricultural insurance is consistent with the findings by Bozzola & Finger, (2021) in Ghana as well as He, Rejesus, Zheng, & Yorobe (2018) who reported symmetric information on agricultural insurance among farmers in the Philippines. Training is therefore critical as it creates understanding and a positive mindset toward agricultural insurance.

6.3.1.4 Farmers' trust in the agricultural insurance

Trust emerged as a key pathway through which farmers adopt agricultural insurance. Findings considered trust to depend on three main factors. First is the level of financial literacy a farmer who had exposure to financial services had positive perceptions about the whole business of agricultural insurance. Secondly, trust was found to be built through trainings and networks among farmers which equipped their understanding of how agricultural insurance works. This was evidenced by the fact that farmers who belonged to farmer groups were more likely to access trainings and interact more, hence more likely to be unwieldable about agricultural insurance. It is also worth noting that trust can be linked with the gender characteristics of the farmer since they are likely to affect farmer access to trainings as well as their level of networks. For example, male farmers are more likely to be socially mobile and have more networks than female farmers in the cultural context of Uganda where women spend a great deal of their time in domestic work.

Probing farmer groups leaders on the issue of trust revealed that farmers need to trust the insurance products, services and providers to buy insurance premiums. Their view indicated that farmers choose to subscribe to agricultural insurance but and increase the magnitude of crop insurance cover by increasing the demand for agricultural insurance as they gain more trust in the insurance. After adoption, trust was built through positive experiences particularly with regard to timeliness of premium pay-outs. However, negative experiences were found to create distrust and dissatisfaction among adopters hence leading to dis-adoption or drop-out. Similarly, Cole et al. (2013) and Cole, Stein & Tobacman (2014) observe that farmers must trust the insurer for them to pay for agricultural insurance. This author cites a case of Gujarat and Andhra Pradesh in India where, using local agents to advertise insurance increased the uptake of agricultural insurance by 36%. The positive effect of trust on the uptake of agricultural insurance is further supported by Giampietri, Yu, & Trestini, (2020) and Karlman, Osei & Udry (2014) from field experiments in Ghana which revealed that farmers who obtained insurance in a previous period increased their insurance demand

6.3.2 Farm characteristics or economic significance of the farm

The major production purpose of the farm which was also correlated with the farm size and level of capital investment had a significant effect on the adoption of agricultural insurance. Its significance is linked with the economic significance of the farm, level of a farmer's risk consciousness and willingness to adopt agricultural insurance. Findings also revealed that many farmers were commercially oriented besides pursing a subsistence objective alongside. This kind of farm purpose amidst low uptake of agricultural insurance presents a great risk to farmers. On the other hand, it can be perceived as an opportunity for farmers to demand agricultural insurance for as long as insurance can be factored into their investment plans. To the Government, the commercial goal of farmers presents an opportunity for scaling up agricultural insurance.

This finding and arguments are consistent with those of Kahan (2013) and Kassie et al. (2012) who generally observes that commercially oriented farms with high capital investments are more risk-conscious and therefore embrace any opportunity to minimize farm risk to safeguard their investments from potential losses. Similar findings are also reported by Ajiboye et al. (2018) in the context of the uptake of agricultural insurance in Nigeria. The significance of risk consciousness is consistent with the findings by Sookhtanlou (2019) that non-adopters of insurance had significantly higher risk aversion compared with the adopters of insurance among maize farmers. Arguably, agricultural insurance is perceived by farmers as a viable risk management or aversion strategy to invest in, hence more risk-conscious farmers being more likely to invest in agricultural insurance.

From the empirical findings presented and discussed in this sub-section, a farm-level conceptual model for determinants of agricultural insurance adoption in a climate risk context has been derived (Figure 6.3). In a nutshell, the empirical analysis has generated sufficient evidence to affirm that the adoption of agricultural insurance in the context of smallholder farmers affected by climate change primarily depends on the characteristics of the farmers and their farms. Notably, this derived conceptual model differs slightly from the conceptual framework which was derived from empirical studies and fronted to guide the empirical analysis in this study

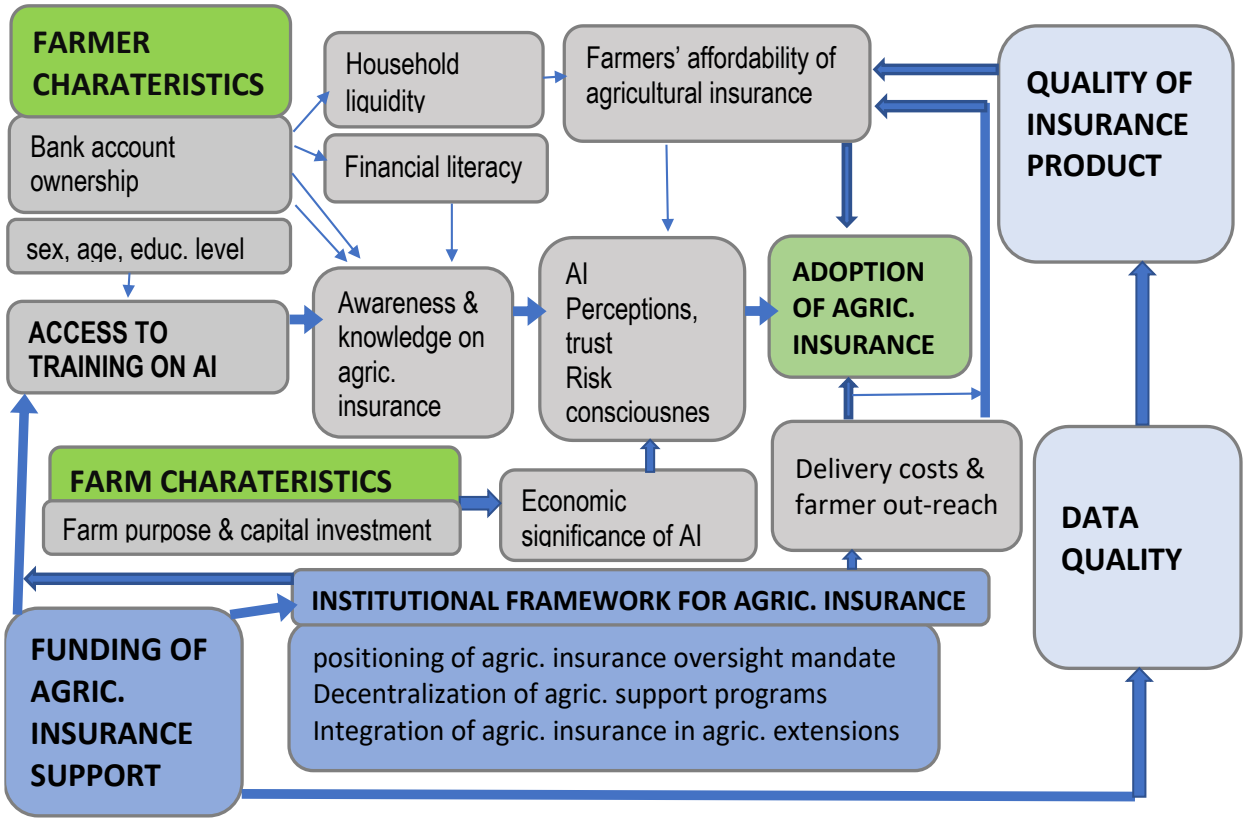


Figure 6.3: A holistic conceptual model for uptake of agricultural insurance: A nexus between demand supply factors

Note: *shaded in green are the underlying demand side factors, blue are the underlying supply side factors while grey are the causal mechanisms through which the demand and supply side constraints manifest to affect adoption of agricultural insurance shaded in orange color. Highlighted in the bold arrow are the key causal mechanisms through which the underlying supply side factors in dark blue boxes (funding and institutional framework) manifest to affect adoption of agricultural insurance*

The derived conceptual model **(Figure 6.3)** presents a more holistic view of the supply and demand side factors which affect adoption of agricultural insurance. It identifies the linkage of the supply to the demand factors. Specifically, the conceptual model identifies two underlying supply side factors which largely leverage the prevailing supply side constraints which manifest to affect adoption of agricultural insurance depicted in the revised conceptual model. The factors are; funding and the institutional framework. Any gaps in these two factors significantly hinders adoption of agricultural insurance. In addition, clear causal mechanisms through which funding manifest to breed the exiting supply and demand supply constraints has been highlighted in with bold arrows.

The model suggests that funding is the primary underlying supply side factor to adoption of agricultural insurance which though manifested as a constraint adoption of agricultural insurance in the context of this study. It can shape or strengthen the institutional framework for adoption of agricultural insurance since it can enable institutional adjustments to address prevailing institutional barriers to effective and efficient delivery of more economically meaningful agricultural insurance products and services to farmers. Funding is also a key determinant for scaling up capacity building programs such as agricultural insurance training which bears significant potential to build an adoption enabling mind-set characterized by risk consciousness as well as positive perception about agricultural insurance in terms of its economic significance and farmers' trust in the underwriters. In addition, funding is critical to addressing data quality constraints and developing more economically meaningful insurance products which are affordable and appreciated by farmers towards enhanced adoption of agricultural insurance.

Regarding the intuitional framework, the study identified two main elements which are critical for effective delivery of agricultural insurance which though manifested as to adoption of agricultural insurance from their detailed analysis in this study. They are; the strategic positioning of agricultural insurance in the climate change adaptation framework and the structural positioning of the mandate for management and delivery of agricultural insurance to farmers. The structural position of agricultural insurance dictates the delivery approach which on one hand affects delivery costs and affordability of agricultural insurance with an ultimate impact on adoption. The delivery approach on the other hand affects farmer out-reach with trainings and sensitizations which subsequently affect farmer's knowekedge perceptions, trust and demand for agricultural. The conceptual model suggests that agricultural insurance can effectively and efficiently be promoted when mainstreamed in the decentralized agricultural extension system and directly managed by the structures with technical capacities in agricultural extension at local government and central government levels. The decentralization can be effective when complemented with adequate capacity building targeting the relevant persons within the local government structures who would play a role to promote adoption of agricultural insurance. This would be a means of building local adaptive capacity for effective implementation and management agricultural insurance support interventions.

From the demand side perspective, financial literacy is a new factor which was added in the new conceptual model and linked with knowekedge about agricultural insurance with regard to its effect analysis. Additionally, financial literacy was conceptualized to depend on farmers; gender characteristics and their level of organization in term of membership to farmer groups, ownership of bank account and savings. Previous conceptual perspectives underscored the significance of these farmers' characteristics with no clear view of how they relate with farmers' gender characteristics, membership to farmer groups, ownership of a bank account manifest and manifest to affect adoption of agricultural insurance. The derived conceptual model suggests that besides insurance trainings which dominates the previous conceptual perspectives, agricultural insurance knowekedge can be built through financial literacy which will depend on level of farmers' level of organization associated with higher chances of exposure to agricultural insurance even in absence of a structured training program.

The model also introduces a dimension of farmers' mind-set towards agricultural insurance which is more of a holistic view of the factors including' perceptions of economic significance insurance, trust in the insurance providers as well as risk averseness and risk consciousness which have been underscored in the current study to affect adoption of agricultural insurance. There was no clear attempt in previous conceptual perspectives to relate these factors for amore holistic view of their significance. In addition, level of risk averseness is also a direct gender issue that has been specifically conceptualized to depend on age, sex, and household size, a knew knowekedge thread which was also deficient in previous conceptual perspectives The model as another new knowekedge thread further identifies the significance of farm characteristics to adoption of agricultural insurance and relates farm size and production with level of capital investments which bears a significant implication on the farmers' risk consciousness and ultimately impact on choice for adoption of agricultural insurance.

6.4 Summary

The chapter has presented empirical perspectives on determinants of farmers' adoption of agricultural insurance deriving facts from empirical data from farmers in Bududa district. Before delving into agricultural insurance determinants, the chapter first highlighted the climate risks and conventional adaptation mechanisms to try and position agricultural insurance within the broader framework for climate change adaptation in the farming context. The chapter has specifically provided a descriptive analysis of climate risk and adaptation strategies as well as the extent of their adoption of agricultural insurance. The former is intended to locate the farmers' specific context of climate change adaptation within which the adoption of agricultural insurance is analyzed. The latter has ascertained the distribution in responses for the adoption categories which was critical to take to inform the possibility of advancing to the inferential analysis and to test the hypotheses regarding the determinants for adoption. The determinants for the adoption of agricultural insurance have been presented focusing categorically on; the farmer and farm characteristics using a Chi-square test. The analysis has further estimated a logistic regression model to predicting the significance and magnitude effect of the variables which were hypothesized to affect the adoption of agricultural insurance in this study. Leveraging on the key lessons from the empirical analysis of the determinants for the uptake of agricultural insurance, a conceptual model has been framed painting a clear picture of the nexus between the demand and supply side determinants for adoption of agricultural insurance

CHAPTER SEVEN

FAST-TRACKING ADOPTION OF AGRICULTURAL INSURANCE: SUPPLY-SIDE CHALLENGES AND OPPORTUNITIES FOR UGANDA

This chapter navigates through the supply-side challenges and identifies opportunities to fast-track the adoption of agricultural insurance. It draws largely from document review and interview engagements with key informants in the management and delivery of agricultural insurance to farmers as well as farmers' group leaders.

7.1 Challenges to promoting agricultural insurance: A supply-side perspective

Through engagement with key informants in the management and delivery of agricultural insurance to farmers as well as farmers' group leaders, critical challenges were found to undermine the uptake of agricultural insurance. Uptake of agricultural insurance was found to be constrained by institutional capacity and structural related challenges which manifest to affect demand for agricultural insurance. The institutional challenges concern weak strategic focus on promoting agricultural insurance within the institutional framework for climate change adaptation. In addition, inadequate farmer training and sensitization are associated with limited awareness and knowledge of agricultural insurance among farmers and other stakeholders. Access to accurate weather and farm data is challenging and costly due to limited weather stations and ineffective farming information systems which undermines efforts to design more economically efficient insurance products which can make more economic sense to farmers. Notably, most of these challenges have a linkage with inadequate funding. The structural issues concern how agricultural insurance promotion is organized including; the structural positioning of the mandate to promote agricultural insurance and the centralized nature of agricultural insurance management. In addition, the automated system of agricultural insurance application is not easily compatible with farmers who have not been adequately trained, have limited knowledge about the agricultural insurance application process and have limited access to smartphones and internet access. The chapter unpacks the challenges hereunder and derive a conceptual model which can help to better understand and tackle them.

Weak strategic focus on agricultural insurance

There is a weak strategic focus on promoting agricultural insurance within the institutional framework for climate change adaptation. Uganda has made commendable progress in integrating climate change adaptation in national development plans, as well as agricultural policies and support programs. This has included the development of a National CSA Programme, the National Adaptation Plan for Agriculture, the national Climate Change Policy and the National Determined Contributions. However, this framework has not directly focused on agricultural insurance as a climate change adaptation strategy. The institutional framework has put more emphasis on promoting Climate Smart Agriculture (CSA). Forexample. The NDCs, identifies climate change adaptation as number one priority to addressing key vulnerabilities in sectors, building adaptive capacity at all levels, addressing loss and damage as well as enhancing the resilience of communities, infrastructure and ecosystems (MWE, 2022). However, the NDCs does not mention agricultural insurance or identify the potential role it can play to promote adaptation and build resilience in the context of the farming communities. context.

In the context of crop production CSA practices include; integrated soil fertility management, agro-forestry, crop diversification, conservation agriculture (crop rotation, mulching, use of green cover crops and minimum tillage), intercropping and effective field water management. A wide range of programmes and projects across the country have focused on CSA because of its direct linkage to food security and climate change adaptation. There is limited interventional support for agricultural insurance. The National Adaptation Framework for Agriculture lacks a clear focus on and framework for promoting agricultural insurance. In addition, agricultural insurance is not mainstreamed in the agricultural extension system hence no interventions to promote it in the Local Government Development Plans. In addition, agricultural support programs; previously NAADS and currently operational wealth creation and the parish development model have not mainstreamed agricultural insurance. To affirm the weak strategic focus on agricultural insurance, one of the key informants had this to say;

"Uganda has a robust institutional framework for climate change adaptation. However, agricultural insurance has been given little attention. The national adaptation plan for Agriculture does not put much emphasis on promoting agricultural insurance. So is the Climate Smart Agricultural Program. The agricultural extension program has no focus at all on agricultural insurance. How do you expect then, agricultural insurance to reach the grass root farmer" (KI14 August, 2022).

Inappropriate strategic positioning of the agricultural insurance mandate

The question of whether there is an appropriate structure for the management of agriculture insurance and its implication for the adoption of the insurance was explored using the views of the managers and implementers of the scheme. To this end, findings revealed that; the delivery of agricultural insurance is generally well managed although with some gaps in the management structure which undermines capacity for scaling agricultural insurance uptake

The Ministry of Finance Planning and Economic Development (MOFPED) which is mandated to manage the Agricultural Insurance scheme and provide oversight to its implementation seem to lack technical experts in the agricultural sciences including, agronomy and veterinary which are critical in the assessment of crop losses under yield-based insurance. The ministry lacks the technical capacity in agricultural extension to effectively relay agricultural insurance information knowledge to farmers. Lack of this expertise at MOFPED bears a negative implication on the extent to which the ministry can provide strategic direction to agricultural insurance in the challenging context of agricultural production. Notably, this agricultural science-related expertise lies in the Ministry of Agricultural Animal Industry and Fisheries (MAAIF) which however has no mandate to provide the desired strategic direction to promote agricultural insurance although it holds a slot on the national Technical Working Committee for the Agricultural insurance scheme. There was a thinking among many stakeholders interviewed that MAAIF is better positioned to manage agricultural insurance given its mandate to provide strategic direction to the agricultural sector which includes managing agricultural risks. MAAIF is already providing strategic direction and implementing climate change adaptation programs in agriculture for which agricultural insurance would be part and

partial. This issue of inappropriate structure for promoting agricultural insurance was affirmed by one of the key informants who had this to say;

> *"The biggest challenge I see is the positioning of the mandate to promote agricultural insurance. We are talking about the Ministry of Finance Planning and Economic Development where the agricultural insurance scheme, the main government initiative to promote agricultural insurance is positioned. Much as insurance is a financial issue, we are mainly talking about the agricultural context within which it is promoted. Farming has a lot of dynamics which the Ministry of Agriculture Animal and Fisheries understands better. Similarly, this ministry has the experience and institutional structures for delivering agricultural extension services to farmers. It would have been better positioned to take a leading a leading role in promoting agricultural insurance in partnership with financial service providers. The Ministry of Finance would have been positioned to play her usual financing role" (KI4, August 2022)*

The centralized nature of agricultural insurance management

Agricultural insurance is not mainstreamed in the agricultural extension system, especially within local governments. This is a critical constraint considering the decentralized framework of service delivery in Uganda. This renders the delivery of farmer sensitization and training programs costly with an ultimately negative impact on the cost of supplying agricultural insurance. The Agro-consortium, a private organization mandated by the Government to implement delivery of the agricultural insurance scheme in partnership with insurance companies, reported high costs associated with promoting agricultural insurance regarding sensitizations and trainings of farmers. This remains the main bottleneck to scaling-up agricultural insurance from the supply side. The key argument here is that; the Agro-consortium is meeting high costs associated with travel and facilitation allowances to deliver agricultural insurance messages to the different parts of the country. The Agro-consortium has also to reach the local farmer to monitor, evaluate crop fields as a basis for payment of the insured farmers.

In addition, the Agro-consortium relies on hired experts to assess farmers' crop fields and ascertain the potential loss to inform the insurance decisions. Conversely, the mainstream agricultural extension system has Agricultural Extension Officers at District and Sub-County levels all over the country who would offer this service at a subsidized cost when

mainstreamed in the agricultural extension system. This public agricultural extension system has an already established structure and linkages with farmers. In addition, the technocrats in the agricultural extension system better understand the complex dynamics of the farmers and their farming operations. The only bottleneck would be that these Agricultural Extension Officers lack expertise in agricultural insurance and have thin budgets to match the huge demands of agricultural extension services.

> *"When you have a program whose management and service delivery is centralized, you will struggle to reach the beneficiaries. That's why as a country we went for a decentralized system of governance and service delivery. With agricultural insurance, the Ministry of Finance and Economic Planning allocates funds, and monitors and evaluates the agricultural insurance scheme. The Argo-consortium, a private company implementing the insurance scheme is centrally located. The insurance services such as sensitizations, trainings, applications, and issuance of insurance premiums are all centrally located. The mainstream agricultural extension system particularly the local government structures and key persons are completely out of the picture in the agricultural insurance programs. It's a big gap that is creating inefficiencies in promoting agricultural insurance" (KII5, August 2022)*

The automated system of agricultural insurance application

The other structural challenge concerns the farmers' application process to access agricultural insurance. Through interviews with the Agricultural Extensions agents and the farmer leaders, it emerged that the online application process although advantageous in reducing the time and costs of accessing agricultural insurance, remains complex for farmers.in terms of application. The main constraint is the general "phobia" of online systems among farmers, especially the old generation. These are less likely to embrace online technologies and generally take longer to adopt such technologies. They are more likely to do so after consistent trainings and drawing from the positive experiences of their fellow farmers. Before they test the agricultural insurance services, they are "allergic" to the online system which they perceive to be complex. They are used to the mainstream agricultural extension services which they usually access through the manual application system with the guidance of Agricultural Extension Officers and fellow farmers who are more familiar with the hard copy forms. In addition, many farmers lack internet access to be able to complete and submit their applications for insurance coverage. Unfortunately, the Agro-consortium seems to have no much time and resources to adequately train farmers on the online system for accessing agricultural insurance.

Inadequate funding

The funding challenge emerged quite central on the supply side of agricultural insurance with two major perspectives. First is the capacity to scale-up awareness creation and second, inadequate funds to subsidize the insurance under the agricultural insurance scheme amidst the increasing demand for the subsidy. Uptake of agricultural insurance relies significantly on farmers' awareness creation and training interventions as well as technological innovations which however remain thin on ground due to inadequate investment. Many farmers remain unaware of agricultural insurance and those who have been trained need more trainings to grasp the whole complex idea of agricultural insurance. The local government and grass-root structures that can easily and efficiently build farmer awareness and knowledge about agricultural insurance are also yet to be trained about this innovation. Consequently, few stakeholders in the management and implementation of agricultural insurance particularly at the national level have a clear understanding and can ably articulate agricultural insurance issues.

The Agro-consortium mainly relies on government funding which is insufficient to scale up operations country-wide. The consortium is understaffed with inadequate field officers and field stations to coordinate and take agricultural insurance to the "grass-root" farmers. Trainings are therefore organized at regional levels, not even district levels which cannot tap the grass root farmers. It emerged that the meetings are mainly attended by elite farmers, some agricultural extension agents and opinion leaders in the locality. Although these are expected to disseminate the message to the communities, they are not obliged to do so and there is no mechanism for tracking whether they relay the agricultural insurance message to the grass root farmer. While the MOFPED, MAAIF, and the Agro-consortium recognizes the need for soliciting external funding, there seem to be insufficient capacity, reluctance, and leadership to do so.

In view of the stakeholders interviewed, climate change adaptation programs mainly rely on donor funding, and implementation of the National Climate Change Policy is expected to rely on 70% of funding from donors. The local budgetary allocations for climate change adaptations are small and short-term. Most adaptation projects have been implemented with funds obtained through collaboration and engagement with traditional development

partners with a negligible focus on agricultural insurance. Besides, the Agro-consortium, the Civil Society Organizations implementing interventions towards building capacity for farmer uptake of agricultural insurance remain few and also lack adequate funding to reach as many farmers as they aspire to. Notably, Civil Society Organizations rely on donor funding whose support has been diminishing due to the global economic crisis. To affirm the funding challenges, one of the key informants had this to say;

> *"Uptake of agricultural insurance is promoted through the agricultural insurance scheme, sensitization, and training programs. However, scaling up these programs has been constrained by financial capacity challenges. Despite Uganda Government's effort to increase financial allocations to the insurance scheme, it remains a drop in an ocean considering the millions of farmers whom we have to reach. The capacity of the Agro-consortium needs to be beefed up with more human resource personnel but all this is constrained by the thin budget. There are few donor support programs towards promoting agricultural insurance have been coming up but remain few compared to the wider geographical scope of the farmers" (KI16, August 2022)*

High cost of designing insurance products and providing insurance services

Although a diversity of insurance products is offered, the challenges in developing the products and offering them to farmers undermine the cost-efficiency of promoting agricultural insurance which bears implications to insurance demand. The argument is that when costs of obtaining data, designing and delivering the insurance products to specific farmers are minimized, agricultural insurance premiums could be priced significantly lower to foster the uptake of agricultural insurance particularly in the context of impoverished small-holder farmers.

While Multi-peril crop insurance (MPCI) was preferred, it is not suitable for most smallholder farmers in the study context and Uganda largely who are mixed cropping farmers. In addition, it is associated with high supply costs as it requires up to three on-farm inspections, to make such products. In addition, a pre-condition for MPCI is 7–10 years of historical crop yield data which does not exist at the smallholder farmer level. The National Agricultural Advisory Services–Ministry of Agriculture, Animal Industry and Fisheries (NAADS-MAAIF) and Uganda Bureau of Statistics (UBOS) are ineffective in

providing the much-needed quality data on farming enterprises timely and contextualized to the local context of the farmers. On the other hand, indemnity-based (IBI) and Weather Index Insurance (WII) which would be less costly to deliver faces the challenge of limited access to reliable weather data. This is because of a few ground-weather stations and automatic weather stations across the country some of which are not operational due to a lack of staffing, inadequate maintenance or vandalism. One of the key informants had this to say;

> *The fact is agricultural insurance is expensive to design and deliver to the farmers. It requires a lot of farmer and farm data which is not readily available in the desired quality. There are critical functionality gaps in weather stations and national data bureaus. Farmers are far and widely dispersed and reaching them is too costly. Amidst these constraints which increase the costs of promoting agricultural insurance, financial institutions are striving to minimize costs and maximize profits. It is quite challenging. Even the insurance scheme which is subsidizing agricultural insurance meets a constraint of high costs of reaching farmers" (KII5, July 2022)*

Inadequate awareness and knowledge of agricultural insurance

The general fact is that many farmers lack knowledge about agricultural insurance except for a few whom the training has reached. The general perception among the impoverished smallholder farmers was that" insurance is for the rich. The poor can survive the hard way with God's mercy". Even within the group of trained adopters who would be considered to be adequately knowledgeable, but because of inadequate training, some still perceived insurance as a saving rather than a risk mitigation tool. Some farmers were concerned over the basis risk that the loss experienced is higher than the actual loss experienced and the payout triggered. This is very important to them as they still don't understand how the payouts are determined in view complexity of the premium computations.

Through interviews with key informants at the district and sub-county including agricultural extension agents and key opinion leaders, it emerged that knowledge gaps are indeed a problem not only for farmers but also for these categories of technical persons. The Agricultural Extension Officers are experts in crop and livestock husbandry issues and implement agricultural support programs at the district and sub-county levels of service delivery to the farmers. They know the role of agricultural insurance and appreciate the concept but lack a clear conceptualization of how it is structured and how it can be delivered

or promoted to the farmers. Interviews with insurance providers indeed confirmed that agricultural insurance is more an issue of finance which the agricultural extension agents have barely been exposed to. Notably, the Agricultural Extension Officers or agents are a key pathway to the delivery of agricultural support programs at district and sub-county levels across the country. They are already engaged in promoting climate-smart agricultural programmes in promoting climate change adaptation. They already have established strong networks with farmers and linkages with the mainstream agricultural extension system at the national level. One of the local government technocrats had this to say affirming the challenges of limited awareness and knowledge about agricultural insurance. *"The fact is agricultural insurance is not a familiar concept among farmers. Many think it's for the rich"*

7.2 Opportunities for promoting agricultural insurance in the context of climate change adaptation

Agricultural insurance is well aligned with Uganda's development agenda and the climate change adaptation framework. Findings from the study underscore the importance of agricultural insurance as a climate change adaptation strategy from the perspective of farmers in communities more vulnerable to climate change. This further rationalizes interventions to promote the uptake of agricultural insurance and supports the Government of Uganda's strategic focus on promoting agricultural insurance. It supports realization of the agricultural national development aspirations set out in vision 2040 and operationalized in The National Development Plan III (NPA, 2020) and the agricultural sector strategic plan (MAAIF, 2022). Regarding climate change adaptation, agricultural insurance though loosely addressed in the climate change adaptation framework, is well aligned with the National Climate Change Policy (MWE, 2015), the National Adaptation framework for agriculture as well as the Climate Smart Agriculture (CSA) program promoting climate-smart adaptation technologies (MAAI, 2016). This alignment was earlier unpacked in chapter five. In attest of it, one of the key informants had this to say;

"Yes there is a huge opportunity for promoting agricultural insurance in Uganda, I have already told you about how agricultural insurance is perfectly aligned with the national development agenda and the strategic framework work for growth and transformation in Uganda. There is no doubt that agricultural insurance is quite relevant for the existing national adaptation framework for agriculture and the strategic focus on promoting agricultural financing in Uganda" (KI2, July 2022).

The other opportunity is an agricultural insurance subsidy which is biased to promote agricultural insurance in the farming communities more vulnerable to climate risk. The Government of Uganda since 2017 subsidized agricultural insurance through the agricultural insurance scheme. The scheme offers premium subsidies to a range of crops, livestock, poultry, and aquaculture insurance cover hence offering an opportunity for insuring a variety of farmers. Interviews with farmers in this study revealed that farmers who have accessed agricultural insurance through the scheme consider the insurance to be affordable. Notably, a special subsidy is provided for farmers in high risky areas majorly including those which are highly prone to climate risk. Subsiding agricultural insurance is quite an important point given the low-income status of the smallholder farmers in the farming communities

The agricultural insurance scheme of Uganda is providing a diversity of insurance products hence a range of choices to insure diverse farms. Weather Index Insurance (WII), Area Yield Index Insurance (AYII) product and multi-peril insurance. Weather-based insurance earns farmers a premium compensation when they experience extreme weather conditions leading to moisture deviation far away from the average required for an optimal plant growth. Area yield insurance earn farmers a premium compensation when the yield falls below the expected average due to weather. However, given extreme risks which cannot be directly covered by area yield insurance, farmers have an opportunity to seek multi-peril insurance which can attract premium compensations when yield falls below average arising from any production hazard.

"Talking opportunities for promoting agricultural insurance, the agricultural insurance scheme should be number one in my view. This is an initiative that is making agricultural insurance affordable to farmers through the insurance subsidy with special consideration for farmers in high-risk areas. It has promoted awareness about agricultural insurance. Besides, it has developed a variety of insurance products for farmers (KI3, July 2022)

The study further provided empirical evidence affirming that with training, farmers are more likely to have positive perceptions about agricultural insurance and trust the insurance, hence increasing demand for agricultural insurance. Moreover, findings revealed that the uptake of agricultural insurance improves gradually with increased access to trainings. Considering the complex nature of agricultural insurance and the limited knowledge about it, farmers' sensitizations and trainings therefore should be a great opportunity to promote agricultural insurance as a climate change adaptation strategy. One of the key informants at their central point of implementing agricultural insurance training programs had this to say;

> *While we say many farmers have not had and are not knowledgeable about agricultural insurance, we do appreciate that the few who have learned about it have picked about and adopted it. I consider the districts and communities we have extended the awareness campaigns and trainings through the agricultural insurance scheme. Many of these farmers have taken up agricultural insurance. They do appreciate it. It is a big opportunity in my view. We need to scale up agricultural insurance training programs, create awareness support farmers to adopt" (KI4, July 2022).*

The Government of Uganda has a strategic focus to promote agricultural commercialization and findings from the study revealed that farmers will more likely adopt agricultural insurance when they pursue farming as a business. Market-oriented agriculture is associated with high capital investments, more risk consciousness and demand for agricultural insurance. This is an opportunity to promote agricultural insurance as the Government of Uganda is pursuing an agricultural commercialization strategy. Both the National Development Plan (MAAIF, 2020) and the National Development Plan (NPA, 2020) underscore the desired agricultural transformation from subsistence to commercialization.

The Government of Uganda is delivering agricultural extension services through a decentralized agricultural extension system with strong linkages to farmers. This system can be tapped to effectively and efficiently deliver agricultural insurance to farmers. If mainstreamed in the agricultural extension system, agricultural insurance would be coordinated through the existing structures for coordination of agricultural extension services at central and local government levels. The Agricultural Extension Officers at district and sub-county levels are a huge opportunity for effective and efficient delivery of farmers' awareness and sensitization activities about agricultural insurance.

MAAIF has an already established coordination system with its sister agencies, relevant central government departments, the Agricultural Extension Departments within Local Governments as well as Farmer's Organizations within the farming communities. Agricultural insurance can therefore be effectively coordinated through MAAIF, the Technical Working Group for the Agricultural Insurance scheme, as well as the Agricultural Extension Officers in the Local Governments who are strongly linked with farmer groups at the grass root level. One of the key informants who exceptionally viewed the decentralized service delivery structure and the agricultural extension system as a huge opportunity to promote agricultural insurance had this to say;

> *We have talked about the structural gaps in the positioning of agricultural insurance in terms of it not being mainstreamed in the decentralized agricultural extension system. Let us look at the agricultural extension system in terms of the existing structures, and technical personnel as an opportunity to efficiently promote agricultural insurance and reach the grass-root farmer more efficiently" (KI4, July 2022)*

The Government of Uganda already adopted a Public Private Partnership (PPP) model to promote the agricultural insurance scheme which is an opportunity for creating synergies with the private sector and building sustainable capacity for promoting agricultural insurance. The Government of Uganda through the Ministry of Finance Planning and Economic Development (MOPED), the Agro-consortium and in partnership with private insurance companies and banks, has been implementing the agricultural insurance subsidy scheme earlier alluded to in chapter two. Notwithstanding the funding constraint, the Agro-consortium brings on board the insurance and marketing expertise and is taking lead in creating farmer awareness about agricultural insurance as well as marketing the insurance products to the farming community.

The Agro-consortium is also getting additional support from Civil Society Organizations which despite the low scale of interventions, are providing funding to scale up farmers' awareness about agricultural insurance. The consortium is also extending technical support towards the development of agricultural insurance supply. Civil Society Organizations with financial support or technical assistance from development partners are promoting product and insurance delivery innovations in attempt to address the demand and supply side constraints. Most alluded to by experts in the insurance sector including digital technologies

for the efficient gathering of farm risk and yield data and linking the information with insurance companies and banks. There is also commendable investment in supporting awareness creation and training on agricultural insurance. In addition, the technical team at the Ministry of Finance and the Agro-consortium appeared to commend foreign governments that sponsored their exposure visits and trainings about agricultural insurance from various countries with more developed agricultural insurance systems. The Public Private Partnership approach to promoting agricultural insurance is surely a great opportunity as one of the key informants had this to say;

> *In Uganda generally, the public-private partnership approach like in many sectors such as construction, health, finance, and agriculture, is a great opportunity to promote agricultural insurance. Government alone cannot do enough. It needs the hand of the private sector. It is quite commendable that the policy and strategic framework for promoting agricultural insurance brings on board the private sector financial institutions, civil society organizations, and Donor agencies among other players. These have a great role to play in addressing the financial constraints associated with promoting agricultural insurance, as well as providing expert knowledge and technologies which can work better" (KII7, August 2022)*

7.3 Summary

Drawing from the findings above, the adoption of agricultural insurance from the supply-side perspective is constrained by institutional capacity and structural related challenges which manifest to affect demand for agricultural insurance. The institutional challenges concern weak strategic focus on promoting agricultural insurance within the institutional framework for climate change adaptation where agricultural insurance is loosely addressed. Structurally, the MOFPED which is mandated to manage the agricultural insurance scheme and provide oversight to its implementation lacks technical capacity in agricultural extension. The same applies to the Agro-consortium which is directly marketing and selling the insurance scheme to farmers in partnership with financial institutions. MAAIF which already established an agricultural extension system with strong farmer linkages is directly involved in the implementation of the insurance scheme. The insurance subsidy scheme remains unpopular among farmers. Besides, its automated system of applying for insurance cover remains complex and not user-friendly to the farmers. In addition, inadequate farmer training and sensitization is resulting in limited awareness and knowledge about agricultural insurance among farmers as well as key technocrats and opinion leaders which can popularize it. Access to accurate weather and farm data is challenging and costly due to

limited weather stations and ineffective farming information systems which undermines efforts to design more economically efficient insurance products. Notably, most of these challenges have a linkage with inadequate funding.

The chapter has nevertheless, identified opportunities that can leverage interventions to promote agricultural insurance as a climate change adaptation strategy. First is farmers embracing agricultural insurance through trainings and sanitization programs. They gain a positive mindset towards insurance and willingness to adopt it with awareness and knowledge acquisition. Secondly, agricultural insurance is well aligned with the development framework at the national level and the agricultural sector which earmarked with great potential to realization of growth and economic transformation in Uganda. The government is subsidizing agricultural insurance for farmers with those more vulnerable to climate risks. The subsidy is making insurance affordable to low-income farmers in their perspective. Thirdly, commercialization could foster uptake of agricultural insurance and the Government of Uganda is pursuing an agricultural commercialization strategy. In addition, the agricultural insurance industry is providing diversity of insurance products including; Weather Index Insurance (WII), Area Yield Index Insurance (AYII) products, and multi-peril insurance hence a range of choices farmers can opt for. There is a strategic focus on improving the products to make them better to match the farmers' contextual challenges. In addition, the government has a decentralized agricultural extension system well-coordinated and linked with farmers at the grass-root level. Agricultural insurance can easily be channeled through this system. Last but not least, the Government of Uganda is already promoting agricultural insurance leveraging on the public-private partnership model with a variety of private sector stakeholders already on board offering technical and financial assistance to promote agricultural insurance

CHAPTER EIGHT

STUDY CONCLUSIONS, CONTRIBUTIONS, RECOMMEDATIONS AND OUT-REACH FOR FURTHER RESEARCH

Agricultural insurance remains a viable alternative to complement the conventional adaptation approaches by way of indemnification to reduce the impact of risk associated with climate change. Agricultural insurance is also critical to enhancing farmer access to credit finance for investment in climate change adaptation technologies. Despite its significance, the uptake of agricultural insurance remains low and is an issue of concern in the literature on climate change adaptation. While many countries are making substantive progress in promoting agricultural insurance, lessons identify factors that undermine the demand for agricultural insurance notwithstanding the supply-side constraints. Understanding the national agricultural insurance systems particularly its supply and demand factors in specific farming contexts is therefore critical to strengthening national climate change adaptations. This is also the case in Uganda, an agrarian country with the farming sector highly vulnerable to climate change.

Taking the case of the farming community in Bududa district of Uganda, this study assessed the potential for advancing agricultural insurance as a climate change adaptation strategy. The study specifically assessed how agricultural insurance is mainstreamed in the climate change adaptation framework for Uganda relying on document review and the view of key informants. Secondly, the study analyzed the determinants for the uptake/adoption of agricultural insurance drawing insights from economic theories of adoption and empirical studies. This guided development of the conceptual and econometric models a well a theory which tested empirically. The output from this analysis is an empirically proven conceptual model for promoting the adoption of agricultural insurance with a nexus between demand and supply side factors. Finally, the study identified the challenge and opportunities for promoting agricultural insurance from a supply-side perspective. This last chapter, therefore, presents the study conclusions, recommendations contributions and out-reach for further research.in quest to promote agricultural insurance as an effective climate change adaptation strategy.

8.1 Conclusions

In view of the research question set out in chapter one, as well as the key finding presented on; (i) the positioning of agricultural insurance in Uganda's development and climate change adaptation framework; (ii) the statistical and conceptual models on farmers' adoption of agricultural insurance taking a case of Bududa district and; (iii) the identified opportunities and challenges for promoting the uptake of agricultural insurance from a supply side perspective, the study derives the following conclusions.

Agricultural insurance is logically positioned in Uganda's development framework concerning the development priorities at the national and agriculture sector levels. However, it lacks significant attention in the climate change adaptation framework specifically; the National Adaptation framework for Agriculture and the Climate Smart Program. Its supply lacks strong structural linkages with Local Government service delivery structures and the farmers. This renders the supply of agricultural insurance inefficient. Unless the current structural framework to promote agricultural insurance is re-configured, it could take many years and huge sums of money to reach the millions of farmers across the country.

Adoption of agricultural insurance in the context of smallholder farmers primarily depends on the characteristics of the farmer and the farm which into four fundamental issues which directly affect adoption; They are; farmers' capacity to afford agricultural insurance, their knowledge about agricultural insurance, their trust in the insurance and their level of risk averseness. The farm characteristics relate to farm production purpose which is correlated with the farm size and level of capital investments. The commercialization goal determines the level of risk consciousness and subsequent adoption. Trust directly depends on the perceptions of the quality of the insurance as well as the type of service provider. The level of risk averseness is partly a gender issue that specifically varies by age. The gender characteristic is also associated with access to trainings and knowledge on agricultural insurance. Male and older farmers are more likely to access trainings and thus more likely to acquire agricultural insurance knowledge and adopt it. Level of farmer organization and financial literacy operationalized by the membership to farmer group and possession of a bank account and saving.

From a supply-side perspective, determinants of the adoption of agricultural insurance manifest in three dimensions which play in to affect the demand for agricultural insurance; The dimensions are; (i) the quality of insurance products which determines the economic significance of the insurance product; (ii) the delivery approach which determines the transaction cost, price and affordability of the insurance product and; (iii) the nature of service provider which affect farmers' trust in the insurance. Notably, the delivery approach also determines the extent of outreach to the farmers thereby affecting farmers' awareness and knowledge about the agricultural insurance facility.

Looking at the supply-side constraints more critically, adoption of agricultural insurance is primarily constrained by inadequate funding and the institutional framework. More specifically, inadequate funding constrain capacity to address the exiting structural gaps in promoting agricultural insurance since the necessary reviews to mainstream agricultural insurance in the agricultural extension system at all local levels of governance cannot happen due to lack of funds. Funding is also inadequate to scale-up agricultural insurance awareness and training programmes which bear huge potential to build knowledge and positive perceptions about agricultural insurance among farmers and key stakeholders in local governments. Inadequate funding also means inadequate capacity to address data related challenges which undermine the quality of insurance products and increase cost of agricultural insurance with an ultimate negative impact on its affordability and demand. The institutional framework concerns inadequate mainstreaming of agricultural insurance in the climate change adaptation framework of policies and strategies which creates scarcity of programs targeted-towards promoting agricultural insurance

Regarding the insurance subsidy scheme, a key government program promoting agricultural insurance, efforts to popularize it among farmers have a long way to go. Besides, its automated system of applying for insurance cover remains complex for farmers who generally have a "phobia" of online systems. They are less likely to embrace online technologies and facilities like internet access. In addition, there is inadequate farmer training and sensitization resulting in limited awareness and knowledge of agricultural insurance among farmers as well as key technocrats and opinion leaders which can popularize it. Access to accurate weather and farm data is challenging and costly due to

limited weather stations and ineffective farming information systems which undermines efforts to design more economically efficient insurance products. Notably, most of these challenges have a linkage with inadequate funding.

Nevertheless, the agricultural insurance system presents opportunities that can leverage interventions to promote agricultural insurance as a climate change adaptation strategy. First is embracing agricultural insurance through trainings and sanitization programs. They gain a positive mindset towards insurance and willingness to adopt it with awareness and knowledge acquisition. Secondly, agricultural insurance is well aligned with the development framework at the national level and the agricultural sector which is fronted as an of growth and economic transformation in Uganda. The government is subsidizing agricultural insurance for farmers with those more vulnerable to climate risks. The subsidy is making insurance affordable to low-income farmers from their perspective. Thirdly, commercialization is fostering the uptake of agricultural insurance and the Government of Uganda is pursuing an agricultural commercialization strategy. In addition, the agricultural insurance industry is providing a diversity of insurance products including; Weather Index Insurance (WII), Area Yield Index Insurance (AYII) products, and multi-peril insurance hence a range of choices farmers can opt for. In addition, the government has a decentralized agricultural extension system well-coordinated and linked with farmers at the grass-root level. Agricultural insurance can easily be channeled through this system to fast-track out-reach to the grass-root farmers more efficiently. Last but not least, the Government of Uganda is already promoting agricultural insurance leveraging on the public-private partnership model with a variety of private sector stakeholders already on board offering technical and financial assistance to promote agricultural insurance.

8.2 Contributions of the study

The study has provided a more holistic conceptual view of the determinants of uptake of agricultural insurance from the demand and supply side perspectives and in the specific context of the farming communities vulnerable to climate change. In other words, the study has improved the conceptual framing of how agricultural insurance can be promoted by looking at the demand and supply side constraints. From an analysis of previous empirical studies and the utility maximization theory; a conceptual model for promoting the adoption of agricultural insurance addressing the demand-supply side factors. has been derived. Two key variables are; farm characteristics, farmer characteristics and the quality of the insurance products. The model underscores five fundamental issues which directly affect the adoption of agricultural insurance from the demand side and are linked with the farmer and farm characteristics. They are; farmers' capacity to afford agricultural insurance as well as their level of risk consciousness and averseness. From a supply-side perspective, the adoption of agricultural insurance is viewed in three dimensions that affect the demand for agricultural insurance; (i) the quality of insurance products which determines the economic significance of the insurance product; (ii) the delivery approach which determines the transaction cost, price and affordability of the insurance product and; (iii) the nature of service provider which relate with farmers' trust in the insurance.

The inherent theoretical assumptions linking the adoption of agricultural insurance with the characteristics of the farmer and the farm were tested statistically and causal mechanisms were derived using primary data from farmers in the context of climate change vulnerability. The hypotheses tests have advanced and made clearer the existing knowledge threads as follows; The theoretical assumption in empirical and theoretical literature as well as the conceptual model derived from this study regarding the effect of socio-economic characteristics on the uptake of agricultural insurance has been confirmed. This knowledge thread has been further expanded by establishing a clear pathway through which the socio-economic characteristic particularly age and sex affect the adoption of agricultural insurance.

The study has expanded the scope of applicability of Rogers' theory for the diffusion of technologies and the utility maximization theory in explaining adoption of technologies. The study affirms Rogers' theoretical assumption that the adoption of technologies or innovations depends on the perceptions and attitudes toward the technology among potential adopters which primarily depends on their awareness and knowledge about the technology/innovation. Regarding the utility maximization theory, the study has provided further empirical attest to the theoretical assumption that the adoption of technologies or innovations is a function of the derived utility which depends on some specific attributes of the potential users. The study has further provided empirical attest to behavioral theories such as the TRA and the TPB which underscores the significance of individual beliefs, attitudes, subjective norms, and behavioral choices/decisions

The study has also advanced the knowledge thread on the effect of farmers' access to training on the adoption of agricultural insurance. In addition, the pathway through which training affects the adoption of agricultural insurance has been created with statistical evidence and qualitative viewpoints. The study specifically attests that training influences the adoption of agricultural insurance by building a positive mindset about agricultural insurance which build farmers' trust in the insurance and belief that it is relevant, affordable, and makes economic sense. This factor of training had been largely addressed qualitatively in previous empirical studies depriving the literature of its statistical significance and evidence-based causal mechanisms through which it affects the adoption of agricultural insurance. A new knowledge thread has also been derived from testing the pathway through which gender characteristics affect the adoption of agricultural insurance that is; age and sex of the household head which were found to affect adoption through their moderating effect on access to training on agricultural insurance.

From the analysis of the nexus between demand and supply side factors for the adoption of agricultural insurance which is specified in the holistic conceptual model, the study has generated a new viewpoint that promoting agricultural insurance necessities tackling the linkages between demand and supply side factors. The linkages had not attracted attention in the existing empirical and theoretical perspectives. The study has not only advanced the

concept of farm characteristics in the holistic conceptual model for the adoption of agricultural insurance but has also operationalized it. Additionally, an appropriate hypothesis regarding its effect on the adoption of agricultural insurance was derived and sufficiently tested. More importantly, the construct of farm purpose tested significantly in affecting the adoption of agricultural insurance. It was however found to be correlated with farm size and level of capital investment all of which reflect the economic significance of the farm, for which the effect was tested and affirmed. This bears relevance to the operationalization of this variable in future studies.

Regarding the broader picture of institutionalizing agricultural insurance adaptation, the study has been able to position agricultural insurance within the framework for climate change adaptation and national development. This has not only rationalized the need for scaling up agricultural insurance as a climate change adaptation strategy but also opened insights into the existing gaps in the institutional framework which should be bridged to fully mainstream and promote agricultural insurance. More broadly, on the supply side, the study has identified, structural and capacity gap ad proposed strategies that can address the challenges and effectively promote a demand-driven agricultural insurance facility. The existing opportunities which can be exploited have also been identified.

8.3 Recommendations

Mainstream agricultural insurance for climate change adaptation: The Government of Uganda through MAAIF should mainstream agricultural insurance in the National Adaptation framework and all adaptation programs such as the CSA, and Operation wealth creation. Agricultural insurance can further be mainstreamed in the framework for disaster management in the Office of the OPM as a proactive approach to disaster management. Additionally, the Government of Uganda through the OPM has to re-configure the agricultural insurance delivery channels: With the support of MAAIF, the OPM should mainstream agricultural insurance in the agricultural extension system and empower MAAIIF to take lead in providing a strategic direction to promote agricultural insurance. MAAIF is already providing strategic direction and implementing climate change adaptation programs in agriculture and already has established an agricultural extension system for which agricultural insurance could be part and partial.

The MoFPED in partnership with MAAIF should allocate funds towards building the capacity of local government structures to mainstream, implement and manage agricultural insurance programs under the decentralized framework of service delivery. This will enhance efficiency in the delivery of agricultural insurance to farmers as well as build strong and sustainable linkages with farmers. This should be complemented with financial and technical support to the Local Governments to implement and manage agricultural insurance programs in their jurisdictions. Local Governments need budget lines to implement agricultural insurance. They need training for agricultural extension agents as well as leaders at district and sub-county levels.

All key public and private sector payers in promoting agricultural insurance should scale up investments in farmer trainings and sensitization to build a positive mindset towards agricultural insurance among farmers. With adequate training, farmers will be able to appreciate agricultural insurance and do away with all sorts of negative perceptions around it. The training should also target building farmers' capacity to work with the innovations in the delivery of agricultural insurance such as the automated system for insurance application. Additionally, the players should invest in innovations that can foster efficiency in the development and delivery of insurance products and services to farmers. In addition to the structural changes highlighted in this study, an innovation that can efficiently relay insurance information to farmers, and capture weather and farm data are among others, more critical. Such innovations will minimize the transaction costs of developing and delivering agricultural insurance to farmers, hence rendering agricultural insurance more affordable to the impoverished smallholder farmers

All key public and private sector payers including the relevant ministry departments, academic institutions, civil society organizations, insurance companies, and farmer groups in promoting agricultural insurance need to combine efforts to mobilize resources to scale up investments in interventions, particularly training and innovations which can fast-track the uptake of agricultural insurance. To this end, a resource mobilization strategy can explore the possibility of writing grant proposals to solicit funds from development agencies that have demonstrated commitment to supporting climate change adaptation. The resource mobilization strategy should be built with strong leadership and commitment. It is

envisaged that implementation of the National Climate Change Policy will continue to rely mainly on donor funding and so will the climate change adaptation programs. Mega funding is needed for mainstream agriculture in the local government agricultural extension system and building local government capacity to manage climate change adaptation programs. Investments are also needed to address data quality-related challenges and develop better-quality insurance products. Funding is also required to foster investment in innovations that can efficiently relay information to farmers and capture farm data.

The public and private sector players in promoting agricultural insurance should build on the existing strong foundations to scale up investments in agricultural insurance including; the strategic fit of agricultural insurance with the long-term development plans as well as national and agricultural sector levels; the insurance subsidy under the agricultural insurance scheme which render insurance affordable, the on-going efforts to create awareness about agricultural insurance and the changing perception of farmers as they learn about insurance, the public-private partnership arrangement in promoting agricultural insurance, the strategic investments Government is making to foster agricultural commercialization and address market failures as well as; the idea of mainstreaming agricultural insurance in the existing and decentralized agricultural extension system etc.

International development agencies should priotize and scale-up funding towards interventions with greater potential to address the demand and supplier side barriers to adoption of agricultural insurance in Uganda and other country contexts where similar constraints prevail to hinder adoption of agricultural insurance. On the other hand, the Government of Uganda and other players in promoting climate change adaptation could explore the possibility of promoting alternative risk-sharing mechanisms particularly in situations of catastrophic risks or very intense climate shocks. This leverages on the argument that while agricultural insurance could be a viable formal risk transfer mechanism, it may prove unattractive to insurance providers or too expensive to afford in cases of extreme risks. At national level, tax reliefs or financial grants and sovereign insurance could be possible options. At community level, kinship ties need to be strengthened to enable farmers be able to absorb mild financial shocks as a complement to agricultural insurance

The public and private sector players in promoting agricultural insurance should consider adopting the holistic conceptual model of promoting agricultural insurance addressing the demand and supply side constraints identified in this study. The derived conceptual model presents a more holistic view of the supply and demand side factors which affect adoption of agricultural insurance.

8.4 Limitations of the study and outlook for further research

The study had a few methodological limitations which affect the extent of generalization of the study findings from a geographical point of view in the data utilized to generate empirical findings on determinants of farmer adoption of agricultural insurance only represented farmers who engage in crop production. Farmers in Bududa were found not to engage in livestock production. Hence the generated perspectives on the demand side factors affecting adoption of agricultural insurance cannot be generalized to all farming communities vulnerable to climate change risks. To this end, further research is needed on agricultural insurance adoption in the context of livestock farmers vulnerable to climate change such as the pastoral communities in the Karamoja region of north Eastern Uganda which is highly vulnerable to drought.

The critical issue of income vulnerability and its effect on uptake of agricultural insurance was not adequately addressed in the study due to the data constraints. Specifically, there is a strong empirical attestation that income vulnerability negatively affects agricultural insurance and depends on income diversification. However, the randomly selected sample did not have an adequate representation of farmers who had an off-farm income source which would be relevant in the context of where farm-income is highly vulnerable to climate risks. Further research on determinants for the adoption of agricultural insurance therefore need to target farmers who have diversified income sources to further analysis of the income vulnerability aspect among smallholder farmers in the climate change adaptation context.

Due to financial limitations, the study could not expand the content and geographical scope to compare the determinants of adoption of agricultural insurance with another district where agricultural insurance programs have been more intensive in sensitization and trainings. Bududa district being located in the mountainous region is highly vulnerable to

climate risk hazards but as alluded earlier, due to capacity constraints, the insurance support programs have reached but not heavily been rolled out to the level of some other districts. A comparative analysis with such districts is therefore an area for further research.

Although the choice to adopt agricultural insurance reflects farmers' willingness to pay for the insurance, the analysis did not estimate willingness to pay in terms of the price farmers are willing to pay for the insurance as this was beyond the scope of this study. This is an important aspect that the study recommends for further research. To this end, further research can also estimate the magnitude in terms of crop cover or insurance premiums farmers are willing to buy. This would largely inform government planning to ensure allocation of sufficient insurance subsidies to cover farmers who would decide to adopt agricultural insurance.

Utility and adoption of AI is presumably a function of so many factors which could not be exhaustively fitted in the regression model. Consequently, though significant, the logit model suggested existence of other factors which can potentially determine farmers;' choice to take up agricultural insurance. The analysis of the factors affecting the adoption of agricultural insurance can explore the broader contextual factors including the political dynamics and macro-economic factors within which agricultural insurance is promoted. The macro-economic factors could undermine farm profitability and economic viability of agricultural insurance.

Finally, the study relied on online sources for data on best practices in promoting agricultural insurance in other countries. Presumably, there could have been the latest practices in the better-performing insurance programs in countries such as Kenya, Rwanda, and Ethiopia which were not published yet they would add value to the study. The study could not raise sufficient resources to cross international borders and learn from other insurance programs. Further research is needed to adequately borrow lessons with primary data on strategies to better effectively promote agricultural insurance from countries with better-performing insurance programs. The study further recommends mainstreaming agricultural insurance in the agricultural extension system from national to local government levels. To this end, further research is needed to assess the capacity of local governments to effectively manage and deliver agricultural insurance to farmers.

REFERENCES

Adeyonu, A. G. (2016). Determinants of poultry farmers' willingness to participate in national agricultural insurance scheme in Oyo State, Nigeria. *Applied tropical agriculture, 21(3)* 55-62

Aditya, K.S., Tajuddin K. and Kishoreb, A. (2018). Adoption of crop insurance and impact: insights from India. *Agricultural economics research review, 31 (2),* 163-174

Ajiboye, B.O., Adeyonu, A.G., Faseyi, S.A. & Isitor, S.U. (2018). Factors influencing farmers' choice of agricultural insurance on arable crop production in Kwara State, Nigeria. *Nigerian journal of agricultural economics, 8(1*) 89-100

Adger, WN, Dessai, S, Goulden, M, Hulme, M, Lorenzoni, I, & ...Anita, W. (2009). Are there social limits to adaptation to climate change? *Journal of climatic change,* 93:335–354

Adjabui, J.A. (2018). Farmers' willingness to participate and pay for, and agricultural extension officers' disposition to communicate weather index-based insurance scheme in Ghana, Thesis, Massey University, New Zealand. /https://mro.massey.ac.nz/bitstream/handle/10179/14848/02_whole.pdf?sequence

Afriyie-Kraft, L., Astrid Z. & Damnyag, L. (2020). Adaptation strategies of Ghanaian cocoa farmers under a changing climate *Forest policy and economics, 113 (c)* 102-115

Agaba, B. (2022). Factors influencing adoption of agricultural insurance as a climate change adaptation strategy by cattle producers, Uganda, dissertation, Makerere University, Kampala, Uganda http://dissertations.mak.ac.ug/handle/20.500.12281/12627

Aidoo, R., Mensah, O. J., Wie, P. & Awunyo-Vitor, D. (2014). Prospects of crop insurance as a risk management tool among arable crop farmers in Ghana. *Asian economic and financial review, 4(3),*341–354.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., & Fishbein, M. (1975). A Bayesian analysis of attribution processes. *Psychological bulletin, 82(2), 261.*

Akaranga, S I., & Makau, B. K. (2018). Ethical Considerations and their applications to research: A case of the University of Nairobi. *Journal of Educational Policy and Entrepreneurial Research, 3(12),* 1-9.

Akinola, B.D. (2014). Determinants of farmers' adoption of agricultural insurance: A case of poultry farmers in Abeokuta Metropolis of Ogun State, Nigeria. *British journal of poultry sciences 3 (2)* 36-41

Akinwumi A.M., Adewumi J.R., Obiora-Okeke O.A. (2020). Impact of climate change on the stream-flow of ala river, Akure, Nigeria. *Sustainable water research. Management*; 7(1):1-11.

Al-Emran M. Mezhuyev V. & Kamaludin, A. (2018). Technology acceptance model in M-learning context: a systematic review. *Journal of computer education. (125):*389–412.

Asseldonk, M.V., Muwonge, D. Musuya, I. & Abuce, M. (2022). Adoption and preferences for coffee drought index-based insurance in Uganda. *Studies in agricultural economics*, 162-166

Amador-Ramirez, M. D., Acosta-Diaz, E., MedinaGarcia, G. & Guetierrez-Luna, R. (2007). An empirical model to predict yield of rain-fed dry bean with Multi-year data. Revista Fitotecnia Mexicana, 30(3), 311–319.

Ankrah, D.A., Kwapong, N.A., Eghan, D. &Adarrkwah, F. (2021). Agricultural insurance access and acceptability: examining the case of smallholder farmers in Ghana. Agric & food security 10 (19) 1-14

Arida, I.A., Bordey, F.H. & Luis, P.M. (2017). *Improving the agricultural insurance program to enhance resilience to climate change: Eevidence from rice and corn production in the PPhilippines.* Books on Agricultural Research and Development, South Asian Regional Center for Research and Graduate Study in Agricultural: Philippines. https://www.searca.org/pubs/books?pid=385

Aryal, J.P., Sapkota, T.B., Khurana, R., Ritika, A. & Rahut, D.B. (2020). Climate change and agriculture in South Asia: adaptation options in smallholder production systems. *Environtal Development Sustainability 22,* 5045–5075

Baker S.E., Edwards, R. (2012). How many qualitative interviews is enough? expert voices and early career reflections on sampling and cases in qualitative research. National Centre for Research Methods Review Paper; http://eprints.ncrm.ac.uk/2273/4/how_many_interviews.pdf.

Bao, X.; Zhang, F.; Guo, S.; Deng, X.; Song, J.; Xu, D. (2022). Peer Effects on Farmers' Purchases of Policy-Based Planting Farming Agricultural Insurance: Evidence from Sichuan Province, China. *International. Journal. Of environmental. Research. Public health, (19)* 1-18.

Bashaasha, B., Waithaka, M., and Kyotalimwe, M. (2012). Climate change vulnerability, impact and adaptation strategies in agriculture in eastern and central Africa, ASARECA, Entebbe, Uganda

Bausch, J.C., H.C. Eakin and A.M. Lerner (2018) Adaptation for whom to what? Challenges and op*portunities in agriculture-urban collaboration for climate change adaptation. In: Climate Change in Cities. Springer, Cham, 299-324.*

Becker D. (2016). Acceptance of mobile mental health treatment applications. *Procedia Computer Science, 58(I):*220–227

Benard, H.R. (2000). *Social Research methods: qualitative and quantitative approaches:* Thousand Oaks, CA Sage Publications

Betham, J. (1970). An Introduction to the Principles of Morals and Legislation, eds. J. H. Burnsand H.L. A.Hart, The Collected Works of Jeremy Bentham, London: Athlone

Bharati, R.C., Azad, N.K., Singh, K.M., Chakraborti, S., Chandra, N. and Singh, S.P. (2014). Factors Affecting Adoption of Crop Insurance in Bihar. *Journal of agrisearch, 1(2*): 102-107

Binswanger-Mkhize, H.P. (2012). Is there too much hype about index-based agricultural insurance? *Journal of development studies, 48(2)* 187–200.

Bozzola, M. & t Finger, R. (2021). "Stability of risk attitude, agricultural policies and production shocks: evidence from Italy," European Review of Agricultural Economics, Foundation for the *European review of agricultural economics, 48(3),* 477-501.

Bressan, V., Bagnasco, A., Aleo, G., Timmins, F., Barisone, M., Bianchi, M... Saaso, L. (2017). Mixed-methods research in nursing-a critical review. *Journal of Clinical Nurses;*26 (19-20) 2878-2890.

Busetto, L., Wick, W. & Gumbinger, C. (2020) How to use and assess qualitative research methods. *Neurological Research. Practice, 2 (14)*

Cai, Jing, Alain de Janvry, and Elisabeth Sadoulet. 2014b. Subsidy policies and insurance demand." Economics department, university of Michigan. NBER Working paper. Available at ttps://www.nber.org/system/files/working_papers/w22702/w22702.pdf

Campbell, B. (2022). Climate change impacts and adaptation options in the agri-food system – A summary of recent IPCC Sixth Assessment Report findings. Rome, FAO. https://doi.org/10.4060/cc0425en

Cariappa, A.G., Darshnaben, P., Mahida, P.L & Chandel, B.S. (2020) Correlates and impact of crop insurance in India: evidence from a nationally representative survey. *Agricultural finance review, 81 (2)* 204-221

Carlsen, B. & Glenton, C. (2011). What about N? A methodological study of sample-size reporting in focus group studies. *BMC Medical Research Methodology* 11(1):26.

Carter Michael R. (2011). Innovations for Managing Basis Risk under Index Insurance for Small Farm Agriculture, FERDI Policy Brief no. B41.

Carter, M.R., A. de Janvry, E. Sadoulet, A. Sarris. (2014). Index-based weather insurance for developing countries: A review of evidence and a set of propositions for up-scaling. Working paper.

Carter, MR, Cheng, L, & Sarris, A (2016). Where and how index insurance can boost the adoption of improved agricultural technologies. Journal of Development Economics, Elsevier

Carter, Michael. 2013. Sharing the risk and the uncertainty: public-private reinsurance partnerships for viable agricultural insurance markets. Index Insurance Innovation Initiative Brief 2013-01 and FERDI Policy Brief B78.

Casaburi, L. & Willi, J. (2018). Time versus state in insurance: experimental evidence from contract farming in Kenya. *American economic review,108 (12*) 3778-3813

Chalise, S, & Naranpanawa, A (2016). Climate change adaptation in agriculture: A computable general equilibrium analysis of land-use change in Nepal. Land use policy, *Elsevier, 59(31)* 241-250

Clarke, D.J., Mukerji, S. & Dercon, S. (2012). A theory of rational demand for index insurance. Ph.D. thesis, University of Oxford, England

Cole, S., Bastian, G., Vyas, S., Wendel, C. & Stein, D. (2012). The effectiveness of index-based microinsurance in helping smallholders manage weather related risks. EPPI-

Centre, Social Science Research Unit, Institute of Education, University of London.

Cole, S., Giné, X., Tobacman, J., Topalova, P., Townsend, R. and Vickery, J. (2013). Barriers to household risk management: evidence from India. *American Economic. Journal of applied economics, 5(1)* 104–35.

Creswell, J. (2017). *Research design: Qualitative, quantitative, and mixed methods approach 2nd ed*. Thousand Oaks, CA: Sage Publications

Creswell, J. (2011). *Controversies in mixed methods research*. In N. Denzin & Y. Lincoln (Eds.), The Sage hand book of qualitative research. Thousand Oaks, CA: Sage.

Creswell, J., & Plano Clark, V. (2011). *Designing and conducting mixed methods research (2nd ed.).* Thousand Oaks, CA: Sage

Creswell, J. (2012). *Qualitative inquiry and research design*: *Choosing among five approaches.* Thousand Oaks, CA: Sage.

Creswell, J. (2011). Controversies in mixed methods research. In N. Denzin & Y. Lincoln (Eds.), The Sage handbook of qualitative research. Thousand Oaks, CA: Sage

Creswell, J. (2012). Qualitative inquiry and research design: Choosing among five approaches. Thousand Oaks, CA: Sage.

Cui, X. (2020). Climate change and adaptation in agriculture: Evidence from US cropping patterns. Journal of environmental economics and management, *Elsevier, 101(C).*

Darijani, A. (2017). Factors affecting the adoption of agricultural insurance and providing the sustainable and unsustainable insurance model. *Agricultural economics, 11(2),* 1-20.

Das S.K. (2018). Impact of climate change (heat stress) on livestock: adaptation and mitigation strategies for sustainable production. *Agricultural. revviews, 39(2):*130–136

De Bock, O. & Ontiveros, D.U. (2013). Literature review on the impact of microinsurance, Microinsurance Innovation Facility research paper 35, Geneva: ILO. Available at: <http://www.impactinsurance.org/sites/default/files/repaper35.pdf>.

Deji, Olanike F. 2020. “Gender Implications of Farmers’ Indigenous Climate Change Adaptation Strategies Along Agriculture Value Chain in Nigeria.” In African Handbook of Climate Change Adaptation, 1811–34. Springer.

Deepa, T. (2018). Crop insurance in North Eastern States of India: performance of national agricultural insurance scheme. *International journal of agriculture sciences, 10(11)* -6325-6329

Dercon, S.., Clark, D.J. & Hill, R. (2011) “Basis risk and trust in index insurance provision: can groups provide an alternative?” *Ferdi policy brief 31*

Dercon, S., Hill, R. V., Clarke, D., Outes-Leon, I. & Taffesse, A. S. (2014). Offering rainfall insurance to informal insurance groups: Evidence from a field experiment in Ethiopia. *Journal of development economics, (106),* 132–143.

Dey, I. (1999). *Grounding grounded theory*. San Francisco, CA: Academic Press

Diagne, M, Saito, K, & Diagne, A (2019). The determinants of the adoption of agricultural insurance program: A case of rice in the Senegal River Valley. Paper presented at the sixth international conference, September 23-26, Abuja, Nigeria: ttps://econpapers.repec.org/paper/agsaaae19/295902.htm

Diep, N. A., Cocquyt, C., Zhu, C., & Vanwing, T. (2016). Predicting adult learners’ online participation: Effects of altruism, performance expectancy, and social capital. *Computers and Education, 101*, 84–101. https://doi.org/10.1016/j.compedu.2016.06.002.

Elabed, G., Bellemare, M.F., Carter, M.R., Guirkinger, C. (2014). Managing basis risk with multiscale index insurance. *Agricultural Economics 44(4-5),* 419-431

Eludoyin A.O., Nevo A.O., Abuloye P.A., Eludoyin O.M., Awotoye O.O. (2017). Climate events and impact on cropping activities of small-scale farmers in a part of southwest Nigeria. *Weather, climate, and society,9 (2*):235–253

Esteve, P, Varela-Ortega, C, Blanco-Gutiérrez, I, & Downing, T. (2015). A hydro-economic model for the assessment of climate change impacts and adaptation in irrigated agriculture. *Elsevier (120)* 49-58

Faber, S., Geenhuizen M.V. & Reuver M.D. (2017). Adoption factors in medical hospitals: a focus on the Netherlands. *International journal of medical information, 100:*77–89. doi: 10.1016/j.ijmedinf.2017.01.009

Fahad et al. (2018). Evaluation of Pakistani farmers' willingness to pay for crop insurance using contingent valuation method: the case of Khyber Pakhtunkhwa province Land Use Policy

Farayola, C.O., Adedeji, I.A., Popoola, P. O. & Amao, S. A. (2013) Determinants of participation of small-scale commercial poultry farmers in agricultural insurance scheme in Kwara State, Nigeria. *World journal of agricultural research, 1(5):* 96-100.

Feola, G, Lerner, AM, Jain, M. & Montefrio, M.J.F, (2015). Researching farmer behaviour in climate change adaptation and sustainable agriculture: Lessons learned from five case studies. *Journal of rural studies 39(2):*74-84

Financial Sector Deepening (2018). Review of FSD's index-based weather insurance initiatives. Financial Sector Deepening Uganda (FSD), Kampala, Uganda

Food and Agricultural Organization of the United Nations (2011). FAO-adapt framework programme on climate change adaptation. Available at https://www.preventionweb.net/publication/fao-adapt-faos-framework-programme-climate-change-adaptation

Food and Agricultural Organization of the United Nations (2016). Integrating Agriculture in National Adaptation Plans (NAP-Ag) Inception Report, Kampala, Uganda

Fusch, P.I. & Ness, L.R. (2015) Are we there yet? Data saturation in qualitative research *Qual Rep;20(9):*1408–16.

Gallopin, G.C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global environmental change, 16:* 293-303.

Gbigbi, T.M. & Ikechukwuka, I. (2020). Agricultural insurance welfare and climate change adaptation decision: evidence from Nigeria analysis of the nexus in agricultural insurance welfare. *Journal of agricultural sciences, 30(1)* 100 – 114

Ghimire, Y.N., Timsina, K.P., Kandel, G., Devkota, D., Thapamagar, D.B., Gautam, S. & Sharma, B. (2016). Agricultural insurance issues and factors affecting its adoption: A case of banana insurance in Nepal. *Nepalese horticulture 11(1):* 75-82

Giampietri, E., Yu, X. & Trestini, S. (2020). The role of trust and perceived barriers on farmer's intention to adopt risk management tools. *Bio-based and applied economics* 9(1): 1-24

Government of Uganda, (2010). Vision 2020. Available at http://www.npa.go.ug/wp-content/uploads/2021/02/vision-2040.pdf

Gul, S., Parveen, Q. & Muhammad, I.Y. (2016). Ethics of conducting research in social sciences at the university level in Pakistan. *Global social sciences review, 3(4)* 486 – 497

Greatrex, H., Hansen, J. W., Garvin, S., Diro, R., Blakeley, S., Le Guen, M., Rao, K. N. & Osgood, D. E. (2015). Scaling up index insurance for smallholder farmers: Recent evidence and insights. CCAFS Report No. 14, Copenhagen.

Giri M., Bista G., Singh P.K., Pandey R. (2021) Climate change vulnerability assessment of urban informal settlers in Nepal, a least developed country. Journal of clean. Production, 307, 127213.

Hanna, E.G.; Tait, P.W. (2015). Limitations to thermoregulation and acclimatization challenges human adaptation to global warming. *International journal of environtal research and public. Health 12,* 8034–8074.

Hazarika, C. & Yasmin, S. (2017). Adaptability of Crop Insurance as a Risk Mitigation Mechanism by the Farmers of Assam–An Analysis of Modified National Agricultural Insurance Scheme (MNAIS). Indian Journal of Agricultural. Journal of advanced agricultural technologies 5(1):58-62

Hazell, P., Anderson,J., Balzer, N., Clemmens ed, H. A., Hess, U. & Rispoli, F. (2010). the potential for scale and sustainability in weather index insurance for agriculture and rural livelihoods. IFAD and World Food Programme, Rome. /www.ifad.org/documents/38714170/40239486/

He, J., Rejesus, R., Zheng, X. & Yorobe, J. (2018) Advantageous selection in crop insurance: theory and evidence. *Journal of agricultural economics, 69(3):*646–68

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica, 47(1),* 153–161. https://doi.org/10.2307/1912352

Henninka, M. & Bonnie N.K. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests, *Elsevier, (292)*

Hickey, C. (2018). Research Ethics in Social Research: Dublin, Ireland: Centre for Effective Services

Hill, R.V. & Robles, M. (2011). Flexible insurance for heterogeneous farmers: results from a small-scale pilot in Ethiopia. IFPRI discussion paper 1092.Available at https://ideas.repec.org/p/fpr/ifprid/1092.html

Hill, R.V., Hoddinott, J. & Kumar, N. (2013). Adoption of weather-index insurance: learning from willingness to pay among a panel of households in rural Ethiopia. *Agricultural Economics 44 (4-5*) 385-398

Ibitoye, S. J., & Saliu, O. J. (2019). An Evaluation of the Performance of Nigeria Agricultural Insurance Scheme in Kogi State, Nigeria. *Asian journal of agricultural extension, economics & sociology, 33(2)*, 1-9.

Ichendu, C. (2020). Morality and ethics in research. *World Journal of Advanced Research and Reviews; 08(03)*, 171–174

Inter-governmental Panel on Climate Change (2022). Mitigation of climate change: Contribution of working group iii to the fifth assessment report of the intergovernmental panel on climate change; IPCC: Cambridge, UK.

Inter-governmental Panel on Climate Change (2014). Climate change 2014: synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change. core writing team, R.K. Pachauri & L.A. Meyer, eds. Geneva, Switzerland.

Intergovernmental Panel on Climate Change (IPCC) (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption. Special Report. International Labor Organization (ILO) (2012). Can climate be insured? http://www.ilo.org/global/about-the-ilo/press-and-media-centre/news/WCMS_186254/lang-en/index.htm (last accessed on 21 March 2016)

International Growth Centre (2016). Mobile money: Lessons for West Africa. International Growth Centre (IGC), London School of Economic and Political Science, Houghton Street, London WC2A 2AE.

Islam, M.T. & Nursey-Bray, M. (2017). Adaptation to climate change in agriculture in Bangladesh: The role of formal institutions. *Journal of Environmental Management 200* 347-358

Isoard, S., Grothmann, T. & Zebisch, M. (2008). Climate Change Impacts, Vulnerability and Adaptation: Theory and Concepts. Workshop 'Climate Change Impacts and Adaptation in the European Alps: Focus Water. Vienna. https://eve.cranfield.ac.uk/urd/sits.urd/run/siw_ipp_cgi.start

Jay, A (2015). Agricultural insurance innovations breathe new life into pastoralism in Ethiopia. CGIAR Research Program on Climate Change, Agriculture and Food. https://ccafs.cgiar.org/news/agricultural-insurance-innovations-breathe-new-life-pastoralism-ethiopia

Jensen, Nathaniel D. & Barrett, Christopher B. & Mude, Andrew G. (2017). "Cash transfers and index insurance: A comparative impact analysis from northern Kenya," *Journal of development economics, Elsevier, 129(c),* 14-28.

Jørgensen, S.L., Termansen, M., & Pascual, U. (2020). Natural insurance as condition for market insurance: Climate change adaptation in agriculture. Ecological Economics, *Elsevier, 12* 91-230

Kahime K, Bounoua L, Messouli M. Boussaa S. and Boumezzough A. (2017). Eco-adaptation strategies of health to climate change: case of zoonotic cutaneous leishmaniasis (ZCL) as vulnerability indicatorin pre-Saharan region of Morocco Environmental Change and Human Security in Africa and the Middle East ed M Behnassi and K Mcglade (Cham: Springer) 117–31

Karlan, D., Osei, R., Osei-Akoto, I., Udry, C. (2014). Agricultural decisions after relaxing risk and credit constraints. *Quarterly journal of economics, 129(2)* 597–652

Kath, S. & Kanagasabapathi, K. (2020). Adaptation strategies followed by the farmers of Nagaland state to overcome the adverse effects of climate change in agriculture in Nagaland, *India plant archives, 20(2)* 4187-4189

Khanal, U., Clevo, W., Viet-Ngu, H. & Lee, B. (2019). "Impact of community-based organizations on climate change adaptation in agriculture: Empirical evidence from Nepal," *Environment, Development and Sustainability, 21(2),* 621-635

Kilimo Salama (2011). Index-based Agriculture Insurance: A Product Design Case Study. International Finance Corporation (IFC). World Bank Group. Available at: http://hdl.handle.net/10986/21682 (accessed on: 6 December 2021)

Kislingerová, Sofia, and Jindřich Špička. (2022). Factors influencing the take-up of agricultural insurance and the entry into the mutual fund: A case study of the czech republic. Journal of risk and financial management 15 (8) 366 https://doi.org/10.3390/jrfm15080366

Khan, N.A., Gao, Q. & Abid, M. (2020). Public institutions' capacities regarding climate change adaptation and risk management support in agriculture: A case of Punjab

Province, Pakistan. *Science Rep 10, 14111*. https://doi.org/10.1038/s41598-020-71011-z

Khan, R., Qudrat-Ullah, H. (2021). Technology Adoption Theories and Models. In: Adoption of LMS in Higher Educational Institutions of the Middle East. Advances in Science, Technology & Innovation. Springer

Komarek, A. (2010). The determinants of banana market commercialization in Western Uganda African journal of agricultural research 5(9):775-784 DOI:10.5897/AJAR09.022

Krishna, U.H., Kumayi, V.R., Suhasini, K. & Bhave, M.H.V. (2019). Impact of national agricultural insurance scheme on rice farming in Mahaboobnagar district of Telangana. *Journal of Research, 45(3-4).*

Kumar, S. & Baljinder K.S. (2018). Farmers' perceptions and adaptation strategies to climate change in Punjab agriculture. *Indian journal of agric.l sciences 88 (10):* 1573–81

Kuyo R.O., Muiruri, L. & Njuguna, S. (2018). Organizational factors influencing the adoption of the district health information system in Uasin Gishu County, Kenya. *International journal of medical research & health sciences, 7(10):* 48-57

Knoke, Irene (2014). Final Evaluation: Adaptation to Climate Change and Insurance (ACCI), Kenya. Main report. Deutsche Gesellschaft fürInternationale Zusammenarbeit (GIZ) GmbH. Bonn and Eschborn, Germany.https://www.google.co.ke/url

LaCaille, L. (2020). Theory of reasoned action. Encyclopedia of behavioral medicine, 2231-2234.

Lai P. (2017). The literature review of technology adoption models and theories for the novelty technology. Journal of information system technology management, *14(1):*21–38.

Lee, D.R., Edmeades, S., McDonald, A. & Nys. E.D. (2014). Developing local adaptation strategies for climate change in agriculture: A priority-setting approach with application to Latin America. *Global Environmental Change, (29)* 78–91

Liesivaara, P. and Myyrä, S. (2014). Willingness to pay for agricultural crop insurance in the northern EU. *Agricultural finance review 74(4),* 539-554

Liu, W.; Sun, L. & Tuo, G. (2021). Research on the Influence Mechanism of Agricultural Insurance on Farmers' Income—Based on Moderated Mediating Effect. *Agricultural. Technological. Economics,* 1–15

Locatelli, B., Pavageau, C., Pramova, E. & Di Gregorio, M. (2015). Integrating climate change mitigation and adaptation in agriculture and forestry: opportunities and trade-offs. Climate Change, *Wiley Online Library, 6(6)* 585-598

Ma, D., Su, J., Wang, H., Zhao, Y., Li, H., Li, Y. & Qi, Y. (2021). Sensory-based approaches in psychiatric care: A systematic mixed-methods review. *Journal of advanced Nursing ;77(10):*3991-4004. doi.org/10.1111/jan.14884 10.1111

Marr, A., Winkel, A., Asseldonk, M., Lensink, R. & Bulte, E. (2016). Adoption and impact of index-insurance and credit for smallholder farmers in developing countries: A systematic review. *Agricultural finance review, 76(1)* 94-118.

Mensah, N.O., Fialor, S.C. & Yeboah, E. (2017). Evaluating the constraints to development of Agricultural insurance for cashew crop farmers in Brong Ahafo Region, Ghana. *Open journal of business and management, 5,*215–229

Ministry of Lands Housing and Urban Development, (2013). The national Land use policy, Kampala, Uganda. https://www.jlos.go.ug/index.php/document-centre/land-justice/366-uganda-national-land-policy/file

Ministry of Water and Environment, 2007, National Adaptation Programme of Actions, Department of Meteorology, Government of Uganda

Ministry of Finance Planning and Economic Development (2017). The Uganda Agricultural Insurance scheme: Annual Performance Report Kampala, Uganda

Ministry of Finance Planning and Economic Development (2022). The Uganda Agricultural Insurance scheme: Annual Performance Report, Kampala, Uganda

Ministry of Water and Environment (2015)[a]. National Climate Change Communication Strategy (2017/2021)

Ministry of Water and Environment (2015)[b]. Economic Assessment of the Impacts of Climate Change in Uganda, Final Study Report, Kampala, Uganda

Ministry of Water and Environment (2015c). Uganda National Climate Change Policy, Kampala, Uganda

Ministry of Water and Environment (2022). Updated Nationally Determined Contribution (NDC). Available at https://unfccc.int/sites/default/files/NDC/2022-09/Updated%20NDC%20_Uganda_2022%20Final.pdf

Mitter, H, Schönhart, M, Larcher, M, & Schmid, E (2018). The Stimuli-Actions-Effects-Responses (SAER)-framework for exploring perceived relationships between private and public climate change adaptation in agriculture. *Journal of Environmental Management 209:*286-300. DOI:10.1016/j. jenvman.2017.12.063

Mohammad S. Hossain, G.M., Alam, S.F, Sarker, T., Moniruzzaman, M.D. & Rabbany, G. (2022). Smallholder farmers' willingness to pay for flood insurance as climate change adaptation strategy in northern Bangladesh, *journal of cleaner production, 338*

Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. *European journal of general practice, 24(1*), 9–18

Montanaro, G., Nuzzo, V. & Xiloyannis, C. (2018). Climate change mitigation and adaptation in agriculture: the case of the olive. *Journal of Water and Climate Change; 9 (4),* 633–642. https://doi.org/10.2166/wcc.2018.023

Moore, FC, & Lobell, DB (2014). Adaptation potential of European agriculture in response to climate change. *Nature climate change, (4)* 610–614

Mukhopadhyay, P., Madhabendra, S. & Partha, S. (2019). Determinants of Farmers' Decision-Making to Accept Crop Insurance: A Multinomial Logit Model Approach: Proceedings of International Conference on SCDA. Advances in Intelligent Systems and Computing, 267-275 DOI:10.1007/978-981-13-0514-6_27

Mugambi, C. (2015). Mobile money and insurance in Africa: Whats the connection? KPMG's Africa blog. Available at: http://www.blog.kpmgafrica.com

Mumtaz, M., Antonio, J.P.D., & Saleem H.A. (2019). *Climate change adaptation in the agriculture sector: an analysis of governance challenges in two Pakistani provinces (ed)*. Available at https://www.intechopen.com/chapters/67629

Mustapha Yakubu Madaki, Harald Kaechele & Miroslava Bavorova (2023). Agricultural insurance as a climate risk adaptation strategy in developing countries: a case of Nigeria, Climate Policy, 23:6, 747-762, DOI: 10.1080/14693062.2023.2220672

National Planning Authority (2020). The Third National Development Plan (2020/21 – 2024/25), Kampala, Uganda. http://www.npa.go.ug/wp-content/uploads/2020/08/N

Ndagijimana, M., Van Asseldonk, M.A.P.M., Kessler, C.A., Habonimana, O. & Houtekamer-van Dam, A. (2017). Facing climate change in Burundi with an integrated agricultural and health insurance approach. *Micro-insurance network's annual journal (3)* 32-37).

Ndagijimana, M., Asseldonk van, M., Kessler, A., Ndimubandi, J. (2020). Effect of Villages Savings and Loan Associations on adoption of index-based crop insurance under limited liabilities. Journal of agriculture and rural development in the tropics and subtropics. http://doi.org/10.17170/kobra-202002281031.

Nhan, D.K., Phuong, T.L., Son, N.N., Van, H.V., Tin, N.H, Dang, T.P… Van, H.V.E. (2016). Climate change adaptation strategies for freshwater agriculture in the Coastal Mekong Delta: Farm-scale Opportunities and Water Management Challenges. *Journal of Tropicultura, library, 34* 120-126

Njegomir, V., Pejanović, R. & Maksmovic, G. (2016). Climate change risks, agricultural production, and the role of insurance. *Economics of Agriculture (63) 3* (1015-1029)

Nkomwa, E.C., Joshua, M.K, Ngongondo, C., Monjerezia, M. & Chipungub, F. (2014). Assessing indigenous knowledge systems and climate change adaptation strategies in agriculture: A case study of Chagaka Village, Chikhwawa, Southern Malawi, *Elsevier, (67–69)*164-172

Nnadi, F.N., Nnadi, C.D., Chikaire, J., Umunnakwe, P.C. & Iheanacho, R.A. (2013). Analysis of Rural Cassava Farmers 'Participation in the Nigeria Agricultural Insurance Scheme in Imo State, Nigeria. *Global. journal of science frontier. Research, 13(11)*

Norton, M., Osgood, D., Madajewicz, M., Holthaus, E., Peterson, E., Diro, R., Mullally, C., Teh, T. & Gebremichael, M. (2014). Evidence of Demand for Index Insurance: Experimental Games and Commercial Transactions in Ethiopia. *Journal of development studies, 50(5)*,630–648.

Nd-Gain (2021). Ranking of Country index. https://gain.nd.edu/our-work/country-index/rankings/

Ntukamazina, N., Onwonga, R., Sommer, R., b, Jean Claude Rubyogo, Mukankusi, C.M., Mburu, J. & Kariuki, R. (2018) Index-based agricultural insurance products: challenges, opportunities and prospects for uptake in sub-Sahara Africa. *Journal of agriculture and rural development in the tropics and subtropics,* 118 (2) 171–185

Odening, M. & Shen, Z. (2014). Challenges of insuring weather risk in agriculture. *Agricultural Finance Review, 74(2),*188–199.

Okada, M, Iizumi, T, Sakurai, G, & Hanasaki, N. (2015). Modelling irrigation-based climate change adaptation in agriculture: Model development and evaluation in Northeast China. *Journal of Advances in Modelling Earth Systems, 7(3)*

Omerkhil, N., Kumar P., Mallick M., Meru L.B., Chand T., Rawat P.S., Pandey R. (2020) Micro-level adaptation strategies by smallholders to adapt climate change in the least developed countries (LDCs): insights from Afghanistan. Ecological. Indicators

OXFAM (2018). OXFAM Annual Report 2018-2019. OXFAM, Kampala Uganda

Partey, S.T., & Angela D.D, Zougmoré, B.Z., Ouédraogo, M., Nyasimi, M., Nikoi, G.K., & Huyer, S. (2020) Gender and climate risk management: evidence of climate information use in Ghana, climatic change, 158:61–75 https://doi.org/10.1007/s10584-018-2239-6

Rao, E.S. & Kumar, K.N.R (2019). Implementation Efficiency of National Agricultural Insurance Scheme (Nais) in India–Data Envelopment Analysis (Dea) Approach

Rippke, U, Ramirez-Villegas, J. Jarvis, A., Vermeulen, S. J., Parker, L., Mer, F… Howed, M. (2016) Timescales of transformational climate change adaptation in sub-Saharan African agriculture. *Nature climate change, 6 (6),* 605-609

Robinson, S.; Mason-D'Croz, D.; Islam, S.; Cenacchi, N.; Creamer, B.; Gueneau, A.; Hareau, G.; Kleinwechter, U.; Mottaleb, K.; Nedumaran, S.; Robertson, R.; Rosegrant, M.W.; Sika, G.; Sulser, T.B.; Wiebe, K. (2015). Climate change adaptation in agriculture: Ex ante analysis of promising and alternative crop technologies using DSSAT and IMPACT. IFPRI Discussion Paper. no.01469.

Rogers, E.M. (2003). *Diffusion of innovations (5th ed.).* New York: Free Press

Rossi, A. N., & Armstrong, J. B. (1999). Theory of reasoned action vs. theory of planned behavior: Testing the suitability and sufficiency of a popular behavior model using hunting intentions. *Human Dimensions of Wildlife, 4(3),* 40-56.

Rhodes, E.R., Jalloh, A, & Diouf, A (2014). Review of research and policies for climate change adaptation in the agriculture sector in West Africa. Future agricultures working paper: IFPRI, academia.edu. https://www.researchgate.net/publication/264766582

Saul, E. (2015). Impact of climate change on agriculture and food security in Nigeria: Challenges and adaptation. *Global advance research journal of medicinal plants, 3(1)* 001-009

Salau, et al. E.S., Saingbe, N.D. & Garba, M.N. (2013). Agricultural Information Needs of Small Holder Farmers in Central Agricultural Zone of Nasarawa State. *Journal of agricultural extension, 17(2).* 113-121

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J..Bartlam B. (2017). Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual Quant., 52(4):*1893-1907 https://doi.org/10.1007/s11135-017-0574-8.

Saunders, M. Lewis, P. & Thornhill, A. (2012). *Research Methods for Business Students, 6th Edition.* Harlow: Pearson Education Limited.

Saunders, M.N. &Townsend, K. (2016). Reporting and justifying the number of interview participants in organization and workplace research. *British journal of management*; *27(4):*836–852

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality and Quantity, 52(4),* 1893–1907.

Sen, V. & Nagwanshee, R. K. (2016). Ethical issues in social science research. *Research journal of management. 5(10),* 37-41.

Shaibu, U.M., Ibitoye, S.J., & Ibrahim, M.K. & Shaibu, Y.A. (2019). Modeling the Factors that Influence Farmers' Participation in agricultural insurance scheme in Kogi State, Nigeria: Implications for agricultural policy. *Nigerian agricultural policy research journal, 7(1)*36-41

Shaibu, U.M., Ibitoye, S.J. & Ibrahim, M.K. (2016). Impact of Nigeria agricultural insurance Scheme on farmers' welfare in Kogi state, Nigeria: a propensity score matching approach. *Journal of science and technology 6(1):*64-69

Serfilippi, E., Carter, M. & Guirkinger, C. (2020). "Insurance contracts when individuals "greatly value" certainty: Results from a field experiment in Burkina Faso," *Journal of economic behavior & organization, Elsevier, 180(c)* 731-743.

Shrestha, R.B. & Bokhtiar, S.M. (eds.). 2019. Climate Smart Agriculture: Strategies to Respond Climate Change in South Asia. SAARC Agriculture Centre, Bangladesh

Sihem, E., 2019. Economic and socio-cultural determinants of agricultural insurance demand across countries, *journal of the Saudi society of agricultural sciences. King Saud University & Saudi Society of agricultural sciences, 18(2):* 177–187.

Simon, H.A. (1959). Theories of decision making in economics and behavioral science. *American economic Review 49 (6):* 253–283.

Singh, A. S. & Hlophe, N. M. (2017). Factors affecting adoption of livestock insurance: a case study of livestock farmers in Manzini region, Swaziland. *Research journal of agriculture and forestry sciences, 5(8):* 6–14

Smit, B. and Wandel, J. (2006). Adaptation, Adaptive Capacity and Vulnerability. *Global environmental change 16*:282–292.

Sookhtanlou, M. (2019). Components affecting production risk management on agricultural crops insurance adoption: A case of maize farmers of Moghan plain). *Journal of agricultural economics and development, 32(4)* 299-311

Suresh V, Prabhakar K, Santhanalakshmi K, Maran K. (2016). Applying technology acceptance (TAM) model to determine the factors of acceptance in out-patient information system in private hospital sectors in Chennai city. *Journal of pharmacutical science research, 8(12):*1373–1377.

Tadesse, M. A., Shiferaw, B. A. & Erenstein, O. (2015). Weather index insurance for managing drought risk in smallholder agriculture: lessons and policy implications for sub-Saharan Africa. Journal of *Agricultural and Food Economics, (3)*1–26.

Takahashi, K., Ikegami, M., Sheahan, M. & Barret, C. B. (2016). Experimental Evidence on the Drivers of Index-Based Livestock Insurance Demand in Southern Ethiopia. *World development journal, (78),*324– 340.

Tang, L. & Luo, X. (2021). "Can agricultural insurance encourage farmers to apply biological pesticides? Evidence from rural China," Food Policy, *Elsevier, 105*(C). DOI: 10.1016/j.foodpol.2021.102174

Tarhini, A., Hone, K, Liu, X. (2014). The effects of individual differences on e-learning users' behaviour in developing countries: a structural equation model. *Computer human behavior, (41):*153–163. doi:10.1016/j.chb.2014.09.020

Tigist, M. (2017). Willingness to pay for agricultural risk insurance as a strategy to adapt climate change. Working Papers intend to disseminate preliminary results of research carried out at UNU-MERIT and MGSoG http://www.maastrichtuniversity.nl/governance

Timilsina, S., KhanaL, M., Pradhan, R. Bhattarai, A. & and M. Sapkota, M. (2022). Determinants of farmers' participation in banana insurance in Chitwan district, Nepal. *Journal of agriculture and environment, (23)* 1-13

Uganda Bureau of statistics (2020). Statistical Abstract, 2020. Available at https://www.ubos.org/wpcontent/uploads/publications/11_2020STATISTICAL__ABSTRACT_2020.pdf

UNDP (2018). Climate Change Adaptation in Africa: UNDP Synthesis of Experiences and Recommendations, Bangkok, Thailand. https://www.undp.org/publications/climate-change-adaptation-africa

United Nations Framework Convention on Climate Change (UNFCCC) (2008). Mechanisms to manage financial risks from direct impacts of climate change in developing countries. Technical paper.

Vasileiou, K., Barnett, J., Thorpe, S. (2018). Characterizing and justifying sample size sufficiency in interview-based studies: Systematic analysis of qualitative health research over a 15-year period. *BMC Medical Research Methodology, 18 (148),* 1-18

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46(2),* 186–204

Vermeulen, S.J., Dinesh, D., Howden, S.M., Cramer, L. & Thornton, P.K. (2018). Transformation in practice: a review of empirical cases of transformational adaptation in agriculture under climate change. *Frontiers in sustainable food systems; 2,* 1-17

Vilma, Z. (2018). Implementing ethical principles in social research: challenges, possibilities and limitations. Vocational Training: *J. research and realities, 29 (1)* 19-42

Wairimu, E., Obare, G. and Odendo, M. (2016). Factors affecting weather index-based crop insurance in Laikipia County, Kenya. *Journal of agricultural extension and rural development, 8(7)* 111-121.

Walker, B.J.A., Neil Adger, W., Russel, D. (2015). Institutional barriers to climate change adaptation in decentralised governance structures: transport planning in England. *Journal of urban studies*; 52 (12), 2250–2266.

Wang, S.W., Lee, W.K., & Son, Y. (2017). An assessment of climate change impacts and adaptation in South Asian agriculture. International *journal of climate change strategies and management, 9(4)* 517-534

Wanjira, J.K. (2021). Adoption of climate-smart maize varieties and it impact on household income among small-sclae farmers in Embu County, Thesis, University of Nairobi, Kenya http://erepository.uonbi.ac.ke/bitstream/handle/11295/160742/Wanjira_Adoption%20

Wasti S.P, Simkhada P, van Teijlingen E.R., Sathian B. & Banerjee I. (2022) The Growing Importance of Mixed-Methods Research in Health. Nepal journal of epidemiology, 12(1):1175-1178. doi: 10.3126/nje. v12i1.43633.

Williams P.A., Crespo, O., Abu, M., Simpson N.P.A. (2018) Systematic review of how vulnerability of smallholder agricultural systems to changing climate is assessed in Africa. Environment. Research. Lett. 2018;13(10):

Williams PA, Crespo O, Abu M (2019) Adapting to changing climate through improving adaptive capacity at the local level-the case of smallholder horticultural producers in Ghana. Clim Risk Manag Elsevier 23:124–135

Wilson, B., Sherry, L., Dobrovolny, J., Batty, M., & Ryder, M. (2002). Adoption factors and processes. In H.H. Adelsberger, B. Collis, & J.M. Pawlowski (Eds.), Handbook on information technologies for education and training (pp. 293-307). Heidelberg, Germany: Springer-Verlag

Wollni, M. and Fischer, E. (2015). Member deliveries in collective marketing relationships: Evidence from coffee cooperatives in Costa Rica. *European review of agricultural economics 42(2)*, 287-314.

World Bank (2010c). “Economics of Adaptation to Climate Change: Social Synthesis Report.”

World Bank (2019) Building Climate Resilience: Experience from Nigeria .https://www.worldbank.org/en/results/2019/04/18

World Bank (2019b). Unlocking Agriculture Finance and Insurance in Uganda: The Financial Sector's Role in Agricultural Transformation [Policy Note]. Available at /https://documents1.worldbank.org/curated/en/186951566901268406/pdf/Policy-Note.pdf

World Health Organization (2021). Climate Change. https://www.who.int/heli/risks/climate/climatechange

Wu, B. & Zhang, C. (2014). Empirical study on continuance intentions towards E-Learning 2.0 systems. Behavioral information technology, 33(10)1027–1038. doi:10.1080/0144929X.2014.934291

Yang, X. Bai, Y. Liu, B. (2015). Evaluation of the crop insurance management for soybean risk of natural disasters in Jilin Province, China: 587–599.

Younas, A., Pedersen, M. & Tayaben, J.L. (2019) Review of mixed-methods research in nursing. *Journal of nursing research, ;68(6):*464-72 doi.org/10.1097/

Zhang, Q.; Chen, X. (2019). Empirical analysis of farmers' willingness to demand agricultural insurance and its influencing factors. *N. Horticulture. 23*, 157–163

Zougmoré, R.B., Läderach, P., & Campbell, M. Transforming food systems in Africa under climate change pressure: role of climate-smart agriculture" sustainability 13, no. 8: 4305. https://doi.org/10.3390/su13084305

Appendix 0: The Institutional framework for climate change adaptation in Uganda

Institution	Strategic focus/provision/role in climate change adaptation
International climate change frameworks ○ The UNFCCC ○ The Kyoto Protocol ○ The East African Community Climate Change Policy ○ The Paris Agreement	Commits the Government of Uganda to develop/adopt and implement climate change mitigation and adaptation measures within the international standards
Vision 2040 (NPA, 2010)	A blue print for long-term development towards realization of the desired transformation from a Peasant to a Modern and Prosperous Country by 2040 - Identifies the need to mainstream CCA in the national development agenda is critical
NCCP (MWE, 2012)	Developed to ensure a harmonized and coordinated approach towards a climate-resilient and low-carbon development path for sustainable development - Sets out to address key concerns of climate change adaptation and mitigation with more emphasis on adaptation - Agriculture a key priority sector in management of climate change - CCA strategies critical to enhance resilient, productive and sustainable agricultural systems towards enhanced food security and resilience - Sets out the following strategies for managing climate change: ○ Policies and programs to support climate change management ○ Support research and development ○ Support transfer and diffusion of climate-smart technology and information ○ Support education, awareness raising ○ Capacity development for a range of climate change stakeholders
NDPs 2015-2020 (NPA, 2015)	- A blue-print for guiding investments towards realization of the national development aspirations - Flagged-off integration of climate change adaptation in the national development plans

	✓ Identifies agriculture as the most vulnerable sector to climate change impacts ✓ Provides for integration of CCA measures in agriculture programming at sectoral and local government levels ○ Identifies strategies for managing climate change including; ○ Strengthening the legal and institutional frameworks ○ Multi-stakeholder involvement in tackling the climate change issue ○ Adequate resources for effective implementation of the committed strategies ○ Main streaming climate change adaptation in agricultural programs and projects
NAP-Ag Framework (MAAIF, 2016)	✓ A guiding framework for adaptation strategies and actions in agriculture ✓ Identifies a range of adaptation actions tailored to the agro-ecological zones: ○ Expanding extension services ○ climate information and early warning systems ○ Climate-Smart Agriculture (CSA) ○ Diversification of crops and livestock ○ Post-harvest handling and storage ○ Rangeland management ○ Small scale water infrastructure ○ Research on climate resilient crops and animal breeds ○ Expanding the use of off-grid solar system to support value addition and irrigation
Budget Circular Call [MAIIF, 2017]	✓ Provides for mandatory mainstreaming of climate change management in all sectoral budget framework papers and District Development Plans
Uganda National Climate Change Communication Strategy [UNCCCS] (MAAIF, 2017)	✓ A guiding framework and plan for communicating about climate change issues ✓ Addresses existing gaps in communication, coordination, and dissemination of CCA and mitigation information
Uganda Agriculture Insurance Scheme (UAIS) (MoFPED, 2017)	✓ The main government program promoting agricultural insurance ✓ The scheme seeks to render agricultural insurance affordable to smallholder farmers and ultimately enhance farmers' access to credit. ✓ It offers a special subsidy for farmers in high risk areas including those more vulnerable to climate risks

Climate Smart Agriculture [CSA] Program-2015-2025 (MAAIF,2015)	✓ Promotes CSA practices including; integrated soil fertility management, agro-forestry, crop diversification, conservation agriculture (crop rotation, mulching, use of green cover crops and minimum tillage), intercropping, field water management
National Agricultural Policy	✓ Seeks to realize food and nutrition security as well as improve household incomes through sustainable agricultural productivity ✓ Recognizes climate risk as a key threat to agricultural production
Agricultural Sector Strategic Plan- ASSP [2021-2026] ([MAIIF, 2021)	✓ Strategically positioned to promote farmer access to productivity-enhancing technologies such as high-quality seeds and fertilizers. ✓ Recognizes climate risk as a key threat to agricultural production ✓ Underscores the need to enhance access to agricultural finance
National Focal Point for Climate change under UNFCCC	Coordinates all climate change interventions by the different players in Uganda
OPM Commission on Disaster Management	Coordinates an effective response to climate induced disasters such as droughts and floods
MAAIF	Provides a strategic direction to the implementation of climate change adaptation interventions
MoFPED	Plays a financing role towards effective implementation of the committed strategies
Research Organizations- Makerere University, NARO	Conduct research developing climate-smart technologies such as risk resistant varieties and water resources management technologies
Financial institutions- banks and insurance companies	Develop and deliver financial products and services directly as credit or indirectly through agricultural insurance to foster financial access for CCA
Civil Society Organizations	Mainly engaged in creating awareness and promoting development and uptake of CCA adaptation innovations
Agricultural extension programmes by public (DPO) and private players (NGOs)	Promote adoption and replicate climate adaptation technologies in agriculture
Agro-consortium	Taking lead in implementing the UAIS scheme through, a coalition of 13 insurance companies licensed to underwrite agriculture insurance in Uganda

Appendix 1: Krejcier and Morgan sample size determination table

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Appendix 2: Document review checklist

1. Provisions for agricultural insurance in the climate change adaptation policies and strategies
2. Provisions for agricultural insurance in the agricultural extension system
3. The adaptation measures in the climate change adaptation polices and strategy documents
4. The process, products and structure for agricultural insurance scheme
5. The key stakeholders in climate change adaptation and agricultural insurance and their roles
6. The agricultural insurance scheme provisions
7. The programs under the agricultural insurance scheme
8. Any documented factors or challenges to low adoption of agricultural insurance
9. Any documented opportunities for adoption of agricultural insurance
10. Documented evidence of strategies for promoting uptake of agricultural insurance
11. The status and trends in uptake of agricultural insurance

Appendix 3: Copy of interview guides

Key informant interview guide: For international agencies working on agricultural insurance and climate change adaptation, National level Climate change adaptation and agricultural insurance committees, insurance providers, District technocrats and climate change committees, District political leaders and NGOs working on CC & agricultural insurance in the district Iam a PhD student at Oldenburg University in Germany pursuing a Research study titled ***"advancing agricultural insurance towards climate change adaptation in Uganda.*** The study specifically seeks to identify the barriers, opportunities as well as strategies for promoting uptake of agricultural insurance. As a key player in promoting uptake of agricultural insurance in Uganda, you have been selected to participate in study by engaging in this interview. The interview seeks your experiences and lessons on the interventions, successes, constraints, opportunities and possible strategies for advancing agricultural insurance as a climate change adaptation strategy in the context of the farming communities in Uganda. The information provided will be treated with utmost confidentiality and will only be used for the purpose of generating research evidence to inform strategies for promoting agricultural insurance as climate change adaptation strategy. If you agree to participate in this study, kindly provide your consent by signing the attached consent form.

1. What is your view on the threat of climate risks to the farming communities in Uganda *[probe respondent on vulnerability of farmers to risks of floods, landslides]?*
2. What is your view on the significance of agricultural insurance facility in the context of farming Communities in Uganda?
3. How is agricultural insurance mainstreamed in the CCA framework of Uganda?
4. Share with us your view on the interventional efforts by the Government and private sector players such as banks, insurance companies and CSOs in promoting AI?
5. What models or approaches have been adopted by the Government and private sector players such as banks, insurance companies and CSOs in promoting AI?
6. Kindly share with us your view on the status of uptake of agricultural insurance?
7. What would you consider as the most critical barriers or drivers for uptake of AI?
8. How best can uptake of agricultural insurance be promoted by the different players?
9. Kindly share with us any other comments you think would important in enriching the study

Thank you very much for participating in this study!

Key interview guide for Extension workers and Lead farmers in Bududa district

Iam a PhD student at Oldenburg University in Germany pursuing a Research study titled ***"advancing agricultural insurance towards climate change adaptation in Uganda.*** The study specifically seeks to identify the barriers, opportunities as well as strategies for promoting uptake of agricultural insurance. As a key player in promoting uptake of agricultural insurance in Uganda, you have been selected to participate in study by engaging in this interview. The interview seeks your experiences and lessons on the interventions, successes, constraints, opportunities and possible strategies for advancing agricultural insurance as a climate change adaptation strategy in the context of the farming communities in Uganda. The information provided will be treated with utmost confidentiality and will only be used for the purpose of generating research evidence to inform strategies for promoting agricultural insurance as climate change adaptation strategy. If you agree to participate in this study, kindly provide your consent by signing the attached consent form.

1. What is your view on the threat of climate risks to the farming communities in Bududa district *[probe respondent on vulnerability of farmers to risks of floods, landslides and droughts]*
2. Among the climate change adaptation strategies, agricultural insurance is gaining prominence as a risk sharing or transfer strategy, what is your view on the significance of agricultural insurance facility in Bududa district?
3. How is agricultural insurance mainstreamed in the climate change adaptation framework of Bududa district?
4. Share with us your view on interventional efforts (if any) by Government and private sector players such as banks, insurance companies, NGOs and CBOs in promoting agricultural insurance in Bududa District?
5. What models or approaches have been adopted by the Government and private sector players such as banks, insurance companies, NGOs and CBOs in promoting agricultural insurance?
6. Kindly share with us your view on the status of uptake of agricultural insurance in Bududa district?
7. What would you consider as the most critical barriers or drivers for uptake of agricultural insurance among farmers in Bududa district?
8. How best can uptake of agricultural insurance be promoted by Government and private sector players in Bududa district?

Thank you very much for participating in this study!

Appendix 4: Copy of Questionnaire for key informants
QUEATIONNAIRE FOR HOUSEHOLD SURVEY

Principal Investigator: Fred Alinda
Oldenburg University
D-26111 Oldenburg
Tel. +256759993670
Email: alindafred@yahoo.com

Dear Sir/Madam

STUDY TITLE: ADVANCING AGRICULTURAL INSURANCE IN UGANDA'S CLIMATE CHANGE ADAPTATION: DETERMINANTS AND MEASURES FOR INSURANCE UPTAKE

Section A: Introduction

Iam a PhD student at Oldenburg University in Germany pursuing a Research study titled ***"advancing agricultural insurance towards climate change adaptation in Uganda.*** The study specifically seeks to identify the barriers and opportunities for uptake of agricultural insurance as well propose strategies to promote adoption of agricultural insurance. As farming household within Bududa district which is highly affected by floods and landslides, you have been selected to participate in study by completing this questionnaire. The questionnaire seeks information about your household, farming enterprise and agricultural insurance as an adaptation strategy to the risk of floods, landslides, and drought. The information provided will be treated with utmost confidentiality and will only be used for the purpose of generating research evidence to inform strategies for promoting agricultural insurance as climate change adaptation strategy. If you agree to participate in this study, kindly provide your consent by signing the attached form.

Section B: Household identification and demographic characteristics

Question	Response
House identification details	
B1. Respondent/ HH identification number	……
B2. District	.....
B3. Sub county	……
B4. Village	……

B5. Indicate your gender	Male ☐ Female ☐
B6.Indicate you highest level of education	Primary ☐ Secondary ☐ Bachelor degree ☐ Masters or PhD☐ Never went to schools ☐
B7. Indicate your age	Number of years……..
B8. How many members do you have in your household?	No. of HH members……..

Section C: Farming and market characteristics

C1. Land allocated for farm production	No. of acres ……
C2. Do you belong to a farmer/savings group?	Yes ☐ No ☐
C3. Do you have a bank account?	Yes ☐ No ☐
C4. Approximately which proportion of your income do you save?	Between …….to……..…..%
C5. What is the main purpose of your farm enterprise?	Subsistence ☐ Commercial ☐
C6. How many hectares of land do you own	No. of hectares.....
C7. For crop enterprises, how many hectares of land are currently under farm production?	No. of hectares.....
C8. For livestock enterprises, how many animals do you own?	No. of animals……..
C9. Where do you usually sell your farm produce?	Retail farm-gate☐ Wholesale farm-gate ☐ Nearest spot market ☐
C10.How far is your home to your nearest market for farm produce	Distance……...Km
C11.How far is your home to the nearest weather station	Distance……...Km

C12.Do you employ hired labor on the farm?	Yes ☐ No ☐
C13. Which of the following modern farming technologies have you adopted on your farm?	Use improved breeds/varieties ☐ Use machinery for land tillage ☐

Section D: Climate risks, climate risk, alternative adaptation mechanisms

Question	Response
climate risk, alternative adaptation mechanisms	
D1. Which of these extreme weather events do you experience most in your area?	Floods ☐ Land slides ☐ Drought ☐ Others ☐
D2. How many times do they occur in a year	Floods….. Landslides …… Drought…… Others……
D3. How intensive/destructive are they when they occur?	Floods: Very intensive ☐ intensive ☐ Mild ☐ Landslides: Very intensive ☐ intensive ☐ Mild ☐ Drought: Very intensive ☐ intensive ☐ Mild ☐ Others: Very intensive ☐ intensive ☐ Mild ☐
D4. How are you copping up with the extreme weather events?	Use resistant breeds/varieties ☐ Adjusted panting dates ☐ Using irrigation technologies ☐ Changed type of farm enterprise ☐ Diversified income sources ☐ Adjusted farming methods eg. Shifted to mixed cropping, minimum tillage, contour ploughing etc.☐ Using agricultural insurance ☐ No adaptation mechanism at all ☐

	Others specify_____

Section E: Agricultural insurance uptake, knowledge, affordability and adoption

Awareness and adoption of agric. Insurance	
E1. Have you ever heard about agricultural insurance?	Yes ☐ No ☐
E2. If yes; have you ever used it?	Yes ☐ No ☐
E3. When did you first use agricultural insurance?	Specify year…….
E4. Are you still using agricultural insurance?	Yes ☐ No ☐
E5. How much insurance premiums were you paid for the last three years you used it *[Specify amount in UGX]*	Year 1; ------ Year2……. Year 3…
E6. If you have never used agricultural insurance, provide reasons	
E7. If you used but stopped, provide reasons for not currently using agricultural insurance	It was not making economic sense ☐ I was not benefiting enough ☐ It became expensive for me ☐ I was not benefiting enough ☐ I Delayed payment of insurance premiums ☐ I lost trust in the insurance provider ☐
Training and knowledge about agricultural insurance	
E8. Have you ever received any training on agricultural insurance?	Yes ☐ No ☐
E9. If yes, how many times have been trained	

E10. How do you rate your knowledge on agricultural insurance	Iam highly knowledgeable about it ☐ Iam adequately knowledgeable about it ☐ have some knowledge about it ☐ I know very little ☐ I know nothing about it ☐
Affordability and willingness to pay (WTP) for agric. Insurance	
E11. How do you rate your ability to afford agricultural insurance	Agric. Insurance is expensive, I can't afford it ☐ Iam not sure whether I can afford it☐ I can afford agricultural insurance ☐
E12. On a scale of 1-5, how do you rate the importance/relevance of agricultural insurance to you	
E13. How much premium are you currently paying for agric. Insurance	Amount……..UGX
E14. Assuming the price of insurance was increased what is the maximum price you would be WTP	Amount……..UGX
E15. For those not willing to pay, assuming the price of insurance was reduced would you be WTP	Amount……..UGX
E16. What is the minimum price at which you would be WTP for agricultural insurance	Amount……..UGX

E17. What would you recommend to be done in order to enhance your willing ness and ability to utilize agricultural insurance?_____
_____
_____

E18. Kindly share with us any other comments you think would important in enriching the study_____

_____

Thank you very much for participating in this study!

Appendix 5: Letter of authorization from the Agro-consortium

Carl von Ossietzky Universität Oldenburg / D-26111 Oldenburg

TO WHOM IT MAY CONCERN

PHD DEGREE RESEARCH

Mr. Fred Alinda is a PhD student at the University of Oldenburg pursuing his doctoral studies in Economics. In partial fulfillment of the requirements for award of the degree, he is conducting a research study titled "Advancing Agricultural Insurance in Uganda's Climate Change Adaptation: Determinants and Measures for Insurance Uptake".

Fred Alinda's research proposal has been accepted by the University to progress to the field and collect data for the research project. This communication therefore serves to formally request you accord him any possible assistance to enable him accomplish his research project which is of great significance to promotion of agricultural insurance as a climate change adaptation strategy.

Thank you for your co-operation on this matter

Yours Sincerely,

Prof. Dr. Bernd Siebenhüner

Carl von Ossietzky
Universität
Oldenburg

School II
School of Computing Science, Business Administration, Economics, and Law
Department of Business Administration, Economics, and Law

Ecological Economics
Prof. Dr. Bernd Siebenhüner
Tel.: +49 441 798 - 4366
bernd.siebenhuener@uol.de

Office
Birgit Schelenz
Tel.: +49 441 798 – 43 84
Fax: +49 441 798 – 43 79
birgit.schelenz@uol.de

Oldenburg, 18/11/2021

Location
Haarentor Campus, Building XY
Ammerländer Heerstraße XY
D-26129 Oldenburg

Postal Address
D-26111 Oldenburg

Parcel Post Address
Ammerländer Heerstraße 114–118
D-26129 Oldenburg

Bank Details
Landessparkasse zu Oldenburg
IBAN DE46 2805 0100 0001 9881 12
BIC SLZODE22

Tax Number
6422008701

www.uol.de/en

Appendix 6: Letter of authorization from the Agro-consortium

Appendix 6: Letter of authorization from the Agro-consortium

Agro Consortium

Our Ref: AIC/HO/057/22

Plot 1 Vale Road, Naguru
P.O. Box 4726, Kampala
Tel: +256 414 660 080 | Email: info@aic.ug | Web: www.aic.ug
Tollfree: 0800111447

10th March 2022

Mr. Fred Alinda
Research Fellow
Uganda Management Institute (UMI)
P. O. Box 20151 Kampala, Uganda
Mobile:0759993670
Email: alindafred@yahoo.com

Dear Sir,

RE: READINESS TO AVAIL INFORMATION FOR RESEARCH STUDY ON ADVANCING AGRICULTURAL INSURANCE IN UGANDAS CLIMATE CHANGE ADAPTATION

Reference is drawn to your letter dated 23rd February 2022 where you expressed interest to conduct a research study on the topic *"Advancing Agriculture Insurance In Uganda's Climate Change Adaptation: Determinants And Measures For Insurance Uptake"*.

The study will be conducted in the smallholder farming community of Bududa district which is prone to climate risk hazards of floods, landslides and drought, at your cost. The research findings are meant to guide stakeholders in the agricultural and insurance sectors to design more effective measures to promote agricultural insurance as a climate change adaptation strategy in Uganda.

We undertake to assist and provide you with information within our mandate on agriculture insurance for this study.

Therefore, do not hesitate to contact the undersigned for any inquiry on our undertaking.

Yours Sincerely,

FOR AGRO CONSORTIUM (U) LIMITED

John Makosya
Senior Consortium Officer

Appendix 7: Copy of approval letter from NCST

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

OUR REF: RESETHICS/05 **25th November 2022**

Dear Chairpersons
Research Ethics Committees
Institutional Animal Care and Use Committees
and
Distinguished Researchers
UGANDA

NATIONAL GUIDELINES FOR COMMUNITY ENGAGEMENT IN RESEARCH

The Uganda National Council for Science and Technology (UNCST) is happy to inform you that the "**National Guidelines for Community Engagement in Research**" have been finalized and are now ready for use by our stakeholders. The purpose of these Guidelines is to provide comprehensive guidance to stakeholders on how to ensure meaningful engagement of communities in research as a strategy for improving the responsiveness to community needs, the quality of research and accountability in research.

As we wait for the Guidelines to be officially launched, we encourage the Research Ethics Committees (RECs), Institutional Animal Care and Use Committees (IACUCs) and researchers to comply with the requirements therein during scientific and ethical review of protocols and implementation of research studies respectively. The Guidelines can be accessed at https://www.uncst.go.ug /. For any further assistance or clarification about the Guidelines, please do not hesitate to send us an email at info@uncst.go.ug or contact us by telephone on +256 414 705 526/ +256 751 600 823/ +256 788 547 694.

We thank you for your cooperation as we promote ethical research in the Country.

Dr. Martin Ongol
ACTING EXECUTIVE SECRETARY

cc: Chairperson, UNCST – Accreditation Committee

LOCATION/CORRESPONDENCE

Plot 6 Kimera Road, Ntinda
P.O.Box 6884
KAMPALA, UGANDA

COMMUNICATION

TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug

Appendix 8: Consent form for key informants
INFORMED CONSENT FORM FOR KEY INFORMANTS

Principal Investigator: Fred Alinda
Oldenburg University
D-26111 Oldenburg
Tel. +256759993670
Email: alindafred@yahoo.com

Dear Sir/Madam

STUDY TITLE: ADVANCING AGRICULTURAL INSURANCE IN UGANDA'S CLIMATE CHANGE ADAPTATION: DETERMINANTS AND MEASURES FOR INSURANCE UPTAKE

Introduction

My name is Fred Alinda, a PhD student at Oldenburg University in Germany. In partial fulfillment for the award of this degree, Ian conducting a research study titled *"**Advancing agricultural insurance in Uganda's climate change adaptation: determinants and strategies for accelerating insurance uptake**".*The study targets a population of 44,861 households prone to climate risk hazards of floods, landslides and drought. Out of these, 380 households have been selected. The information you will provide shall help stakeholders at different levels in the agricultural and insurance sectors to understand the drivers and barriers to promoting agricultural insurance.

Consequently, the study findings will provide evidence-based recommendations on strategies to promote agricultural insurance as a climate change adaptation strategy. This will ultimately enhance resilience of farming communities to climate change risks and promote agricultural growth. This is a self-sponsored project and thus the project costs are entirely a responsibility of the researcher.

Back ground information

Agricultural insurance in many African countries for instance Kenya, Ethiopia, Ghana, Zambia, Tanzania Benin, and Rwanda has proven a viable option for climate change adaptation and building more resilient communities by guarding against disastrous effects of agricultural risks associated with climate change and their (Amador-Ramirez, 2007; Aidoo et al., 2014). Extant literature identifies the need for innovative approaches to address demand related challenges which constrain scale-up of agricultural insurance. The challenges include; farmers' low affordability, risks averseness, lack of trust with the underwriters, high transaction costs and basis risks (Cole et al., 2013; De Bock and Gelade,

2012; Hill et al., 2014 Hazell et al., 2010; Greatrex, et al., 2015; Carter et al., 2014; Binswanger-Mkhize, 2012; Dick et al. 2011; Clarke et al. 2012; Cole et al., 2012; Norton et al., 2014; Takahashi et al., 2016; Mensah et al., 2017). Agricultural insurance systems in countries such as; Kenya, Zambia, Ethiopia present innovative approaches in addressing these challenges and promoting agricultural insurance (Hazell et al., 2010; Casaburi & Willis, 2015; Hill and Robles, 2011; Dercon et al., 2014).

In Uganda, although agricultural insurance is mainstreamed in the climate change adaptation strategies, its uptake remains low and the determinants for uptake are yet to be understood. Besides, there is paucity of knowledge on the challenges and strategies that undermine or foster uptake of uptake of agricultural insurance. Consequently, the potential for agricultural insurance to support climate change adaptation by addressing the agricultural financing challenges that is paramount to enhance farmers' investment in climate change adaptation technologies and innovations such as livelihood diversification, climate change smart technologies remain minimally exploited. Without agricultural insurance, farmers are fully exposed to the climate risk that negatively impact on agricultural production, farm incomes and undermine community resilience to climate change.

What the participant would be asked to do

You have been selected because you are a key stakeholder in in promoting agricultural insurance. The questions asked will be entirely restricted to your own outlook of uptake of agricultural insurance, in terms of the determinants, challenges, opportunities and strategies for improvement. The interview will take between 25 to 30minutes.

Risks and benefits of participating in the study

There are no risks envisioned in this study. Should you feel psychologically threatened in responding to any question in the study at any point, you will be free to retract from answering such a question or stop participating in the study entirely.

There are no direct benefits for you, however, your ideas may influence policy direction towards enhanced uptake of agricultural insurance as a climate change adaptation strategy, should the findings and recommendations of the study be taken on by the relevant stakeholders.

Confidentiality

The answers you give will only be known to us and will be kept confidential. Your names shall not be taken instead, anonymous identifiers will be used, and referred to during the presentation of findings so that no names shall be tagged to particular responses. All

answers provided shall only be known to the research team and will be kept confidential. The filled questionnaires shall be kept and lock and key confidentially kept by the researcher

Dissemination

You will be given feedback on the study findings in form of a report which will be sent to you at a free cost. The findings will be packaged in a simpler manner that you will be able to read and understand the emerging issues on advancing agricultural insurance as a climate change adaptation strategy. The researcher will take time to present the findings to you in a mini workshop which will be organized by the researcher at his cost.

Voluntariness

Your participation is voluntary and will incur you no cost. None participation will not incur any penalty. In case you are not interested in the study, you do not have to participate. One of your rights to participate in this study is that you can withdraw from this study at any time you feel like.

Compensation /Reimbursement

There will be no reimbursement for your participation in this study since you will be found at your work place and it is not envisaged that there will be any cost incurred in relation to the study. However, you will be given a compensation of |UGX 50,000 for your time.

Ethical Consideration.

This study has been approved by the Makerere University School of Social Sciences Research Ethics Committee and the Uganda National Council of Science and Technology.

Contacts and Questions

The researcher(s) conducting this study are mentioned below. You may ask any questions you have now. If you have any questions later, you may contact them at:

Principal Investigator	Fred Alinda
Institution	Oldenburg University
Other details	PhD Student
Telephone numbers	+256 759993670
E-mail:	alindafred@yahoo.com

If you would like to talk to someone other than the researcher(s) about; (1) concerns regarding this study, (2) research participant rights, (3) research-related injuries, or (4) other human subjects' issues, please contact:

Dr. Stella Neema
The Chair
Makerere School of Social Sciences
Research Ethics Committee
Telephone: +256- 772 457576
E-mail: sheisim@yahoo.com
Or
The Executive Secretary
The Uganda National Council of Science and Technology,
Kimera Road. Ntinda P. O. Box 6884 Kampala, Uganda
Telephone: (256) 414 705500
Fax: +256-414-234579
Email: info@uncst.go.ug
Or

Statement of consent

I have read the above information or had the above information read to me. I have received answers to the questions I have asked. I consent to participate in this research. I am at least ……..…. years of age.

Signature or thumbprint/mark of participant:
…… Date: ……
Signature of person obtaining consent:
…… Date: …….
Witness of person in case person is Illiterate:
Signature or thumbprint/mark of witness:
…… Date: ……

Appendix 9: Copy of consent for farmers
INFORMED CONSENT FORM FOR HOUSEHOLDS
With the clauses as required by the National Guidelines for Conduct of Research Involving Human as Research Participant, July 2014.

Principal Investigator: Fred Alinda
Oldenburg University
D-26111 Oldenburg
Tel. +256759993670
Email: alindafred@yahoo.com

Dear Sir/Madama

STUDY TITLE: ADVANCING AGRICULTURAL INSURANCE IN UGANDA'S CLIMATE CHANGE ADAPTATION: DETERMINANTS AND MEASURES FOR INSURANCE UPTAKE

Introduction

My name is Fred Alinda, a PhD student at Oldenburg University in Germany. In partial fulfillment for the award of this degree, Ian conducting a research study titled *"**Advancing agricultural insurance in Uganda's climate change adaptation: determinants and strategies for accelerating insurance uptake**".*The study targets a population of 44,861 households prone to climate risk hazards of floods, landslides and drought. Out of these, 380 households have been selected. The information you will provide shall help stakeholders at different levels in the agricultural and insurance sectors to understand the drivers and barriers to promoting agricultural insurance.

Consequently, the study findings will provide evidence-based recommendations on strategies to promote agricultural insurance as a climate change adaptation strategy. This will ultimately enhance resilience of farming communities to climate change risks and promote agricultural growth. This is a self-sponsored project and thus the project costs are entirely a responsibility of the researcher.

Back ground information

Agricultural insurance in many African countries for instance Kenya, Ethiopia, Ghana, Zambia, Tanzania Benin, Rwanda has proven a viable option for climate change adaptation and building more resilient communities by guarding against disastrous effects of agricultural risks associated with climate change and their (Amador-Ramirez, 2007; Aidoo et al., 2014). Extant literature identifies the need for innovative approaches to address demand related challenges which constrain scale-up of agricultural insurance. The challenges include; farmers' low affordability, risks averseness, lack of trust with the underwriters, high transaction costs and basis risks (Cole et al., 2013; De Bock and Gelade, 2012; Hill et al., 2014 Hazell et al., 2010; Greatrex, et al., 2015; Carter et al., 2014; Binswanger-Mkhize, 2012; Dick et al. 2011; Clarke et al. 2012; Cole et al., 2012; Norton et al., 2014; Takahashi et al., 2016; Mensah et al., 2017). Agricultural insurance systems in countries such as; Kenya, Zambia, Ethiopia present innovative approaches in addressing these challenges and promoting agricultural insurance (Hazell et al., 2010; Casaburi & Willis, 2015; Hill and Robles, 2011; Dercon et al., 2014).

In Uganda, although agricultural insurance is mainstreamed in the climate change adaptation strategies, its uptake remains low and the determinants for uptake are yet to be understood. Besides, there is paucity of knowledge on the challenges and strategies that undermine or foster uptake of uptake of agricultural insurance. Consequently, the potential for agricultural insurance to support climate change adaptation by addressing the agricultural financing challenges that is paramount to enhance farmers' investment in

climate change adaptation technologies and innovations such as livelihood diversification, climate change smart technologies remain minimally exploited. Without agricultural insurance, farmers are fully exposed to the climate risk that negatively impact on agricultural production, farm incomes and undermine community resilience to climate change.

What the participant would be asked to do

You have been selected because you are a key stakeholder in in promoting agricultural insurance. The questions asked will be entirely restricted to your own outlook of uptake of agricultural insurance, in terms of the determinants, challenges, opportunities and strategies for improvement. The interview will take between 25 to 30minutes.

Risks and benefits of participating in the study

There are no risks envisioned in this study. Should you feel psychologically threatened in responding to any question in the study at any point, you will be free to retract from answering such a question or stop participating in the study entirely.

There are no direct benefits for you, however, your ideas may influence policy direction towards enhanced uptake of agricultural insurance as a climate change adaptation strategy, should the findings and recommendations of the study be taken on by the relevant stakeholders.

Confidentiality

The answers you give will only be known to us and will be kept confidential. Your names shall not be taken instead, anonymous identifiers will be used, and referred to during the presentation of findings so that no names shall be tagged to particular responses. All answers provided shall only be known to the research team and will be kept confidential. The filled questionnaires shall be kept and lock and key confidentially kept by the researcher

Dissemination

You will be given feedback on the study findings in form of a report which will be sent to you at a free cost. The findings will be packaged in a simpler manner that you will be able to read and understand the emerging issues on advancing agricultural insurance as a climate change adaptation strategy. The researcher will take time to present the findings to you in a mini workshop which will be organized by the researcher at his cost.

Voluntariness

Your participation is voluntary and will incur you no cost. None participation will not incur any penalty. In case you are not interested in the study, you do not have to participate. One of your rights to participate in this study is that you can withdraw from this study at any time you feel like.

Compensation /Reimbursement

There will be no reimbursement for your participation in this study since you will be found at your work place and it is not envisaged that there will be any cost incurred in relation to the study. However, you will be given a compensation of |UGX 10,000 for your time.

Ethical Consideration.

This study has been approved by the Makerere University School of Social Sciences Research Ethics Committee and the Uganda National Council of Science and Technology.

Contacts and Questions

The researcher(s) conducting this study are mentioned below. You may ask any questions you have now. If you have any questions later, you may contact them at:

Principal Investigator	Fred Alinda
Institution	Oldenburg University
Other details	PhD Student
Telephone numbers	+256 759993670
E-mail:	alindafred@yahoo.com

If you would like to talk to someone other than the researcher(s) about; (1) concerns regarding this study, (2) research participant rights, (3) research-related injuries, or (4) other human subjects' issues, please contact:

Dr. Stella Neema
The Chair
Makerere School of Social Sciences
Research Ethics Committee
Telephone: +256- 772 457576
E-mail: sheisim@yahoo.com

Or
The Executive Secretary
The Uganda National Council of Science and Technology,
Kimera Road. Ntinda P. O. Box 6884 Kampala, Uganda
Telephone: (256) 414 705500

Fax: +256-414-234579
Email: info@uncst.go.ug
Or

Statement of consent

I have read the above information or had the above information read to me. I have received answers to the questions I have asked. I consent to participate in this research. I am at least ……..…. years of age.

Signature or thumbprint/mark of participant:
…… Date: ……

Signature of person obtaining consent:
…… Date: …….

Witness of person in case person is Illiterate:

Signature or thumbprint/mark of witness:
…… Date: ……

Email: info@uncst.go.ug
Or

Fred Alinda
Uganda Management Institute
P.O BOX 20131,
KAMPALA, UGANDA
Tel. 0759993670

Statement of consent

I have read the above information or had the above information read to me. I have received answers to the questions I have asked. I consent to participate in this research. I am at least ……..…. years of age.

Signature or thumbprint/mark of participant:
…… Date: ……

Signature of person obtaining consent:
…… Date: …….

Witness of person in case person is Illiterate:

Signature or thumbprint/mark of witness:
…… Date: ……

Statement of consent to participate (in case of additional interviews)

I have read or have had the information read to me about additional interview. I have received answers to the questions I have asked. I am at least …….. years of age.

☐ Yes, I agree to participate in additional interview about …….. at each follow up if selected as

eligible. I understand that I can change my mind and refuse the additional interview

☐ I do not agree to participate in an additional interview about ……. at each follow up visit if

selected as eligible.

Signature or thumbprint/mark of participant:
…… Date: ……

Signature of person obtaining consent:
…… Date: …….

Witness of person in case person is Illiterate:

Signature or thumbprint/mark of witness:
…… Date: ……

Appendix10: Correlation results for farm purpose, use of hired labor and modern farm technologies: SPSS outputs

Correlations

		VAR00001	Main purpose of the farm enterprise	modern_farngtech	labor
VAR00001	Pearson Correlation	1	.372**	.372**	.316**
	Sig. (2-tailed)		.000	.000	.000
	N	291	287	287	283
Main purpose of the farm enterprise	Pearson Correlation	.372**	1	1.000**	.027
	Sig. (2-tailed)	.000		.000	.638
	N	287	320	320	312
modern_farngtech	Pearson Correlation	.372**	1.000**	1	.027
	Sig. (2-tailed)	.000	.000		.638
	N	287	320	320	312
Labor	Pearson Correlation	.316**	.027	.027	1
	Sig. (2-tailed)	.000	.638	.638	
	N	283	312	312	318

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 11: Final regression model for determinants of farmers' adoption of agricultural insurance

Model Summary

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
128.089[a]	.283	.458

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Variables in the Equation

	B	S.E.	Wald	Df	Sig.	Exp(B)
trained_agric_ins	2.049	.571	12.903	1	.000	7.763
purpose_farm_ent	1.659	.511	10.523	1	.001	5.255
bank_acc	1.192	.469	6.460	1	.011	3.294
extreme_weather_magnitude	-.118	.370	.102	1	.749	.888
Average_income_annual	.000	.000	.002	1	.961	1.000
relevance_agirc_ins	.711	.344	4.271	1	.039	2.036
Constant	-3.055	.979	9.747	1	.002	.047

a. Variable(s) entered on step 1: trained_agric_ins, purpose_farm_ent, bank_acc, extreme_weather_magnitude, Average_income_annual, relevance_agirc_ins.

Appendix 12: Regression model for willingness to pay for agricultural insurance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.693[a]	.480	.439	152346.15799

a. Predictors: (Constant), possession of a bank account, farm_land, Main purpose of the farm enterprise, intebsity of occurence of first extreme weather event, farmers' rating of their ability to afford agricultral insurance, Gender of respondent, Average_income_annual, knoweledge, extreme_weather_magnitude, number of members in a household

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2702159912255.790	10	270215991225.579	11.643	.000[b]
Residual	2924378333639.098	126	23209351854.279		
Total	5626538245894.888	136			

a. Dependent Variable: maximun premium rate, farmer would be willing to pay for agric incusrance

b. Predictors: (Constant), possession of a bank account, farm_land, Main purpose of the farm enterprise, intebsity of occurence of first extreme weather event, farmers' rating of their ability to afford agricultral insurance, Gender of respondent, Average_income_annual, knoweledge, extreme_weather_magnitude, number of members in a household

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		

(Constant)	158015.089	141788.183		1.114	.267
number of members in a household	6499.372	6096.200	.083	1.066	.288
Knoweledge	-45408.799	17921.618	-.178	-2.534	.013
farm_land	-96022.273	61807.647	-.104	-1.554	.123
farmers' rating of their ability to afford agricultral insurance	79140.156	38113.625	.137	2.076	.040
Main purpose of the farm enterprise	-70390.867	30829.131	-.169	-2.283	.024
intebsity of occurence of first extreme weather event	-21912.465	31949.193	-.049	-.686	.494
Average_income_annual	.003	.001	.315	4.300	.000
extreme_weather_magnitude	66178.644	21076.504	.229	3.140	.002
Gender of respondent	62562.866	28766.849	.147	2.175	.032
possession of a bank account	-85457.043	32982.528	-.178	-2.591	.011

a. Dependent Variable: maximun premium rate, farmer would be willing to pay for agric incusrance