

**Risk Assessment and Coverage Analysis for Agricultural Insurance
Innovations in Kenya**

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**A dissertation submitted in fulfilment of the requirements for the degree of
Master of Arts in Insurance and Risk Management (by research)**

September 2024



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Abstract

Crop insurance plays a crucial role in mitigating the financial risks farmers face, especially in developing countries like Kenya, where agriculture is a significant contributor to the economy. The current conventional insurance solutions frequently have to sufficiently examine the dynamics of the agricultural risk characteristic of such environments. The research aims to reinvent risk assessment and insurance provision by using satellite imaging, weather sensors, and the application of data analysis combined with new forms of insurance, including index insurance, parametric insurance, and micro-insurance. By adopting a systematic approach to the research, this work aims to improve the efficiency and availability of Kenyan farmer's agricultural insurance products. The advancement of such technology could help lessen the economic volatility brought by volatile climates, destructive pests, and diseases, as well as market volatility, thus strengthening the stability of the farmers and guaranteeing food supply and stability. Further, the research is capable of providing possibilities to boost the economic development of rural areas, encourage ecological and efficient approaches to agriculture, and create poverty reduction and other aspects of socio-economic improvement. Mingling critically with other domains of knowledge in this interdisciplinary endeavour is academically fulfilling while reinforcing the global call for resilience, sustainable, and inclusive agriculture systems deemed socially responsible.

Key Words: Crop Insurance, Risk Assessment, Satellite Imaging, Index Insurance, Sustainable Agriculture

Acknowledgement

I am thankful to the Almighty God for His protection during my studies as well as my entire family for the prayers and support during this time.

I would like to thank my supervisor Dr Andre Farrugia for his guidance. His insights played a significant role throughout my research.

I am also grateful for the stakeholder who took their time to respond to my questionnaires, contributing significantly to the success of this research.

Table of Contents

Abstract.....	ii
Acknowledgement.....	iii
List of Tables	viii
List of Figures	ix
1.0 Chapter 1: Introduction	1
1.1 Background Information on Agricultural Insurance in Kenya	1
1.2 The Role of Risk Assessment and Coverage for Innovations in Agricultural Insurance	3
1.3 Research Problem Statement.....	4
1.4 Objectives of the Study	4
1.6 Significance of the Study	4
1.7 Structure of the Thesis	6
2.0 Chapter 2: Literature Review	7
2.1 Theoretical Framework	7
2.2 Historical development and evolution of agriculture insurance in Kenya.....	9
2.3 Risk Assessment in Agriculture Insurance	9
2.3.1 Risk faced by insurance sectors	9
2.3.2 Risk faced by farmers	10
2.3.3 Differences Between Risk Management and Insurance Effectiveness.....	12
2.4 Coverage Analysis in Agriculture Insurance	13
2.4.1 Index-Based Crop Insurance Services.....	13

2.4.2	Determinants of Uptake and Strategies for Improvement.....	13
2.4.3	Reliable Adoption of Crop Insurance.....	14
2.5	Impact Evaluation of Agriculture Insurance Programs.....	14
2.6	Regulatory Framework and Policy Environment.....	14
2.7	Innovations and Emerging Trends	15
2.8	Challenges and Opportunities	15
2.9	Summary.....	16
3.0	Chapter 3: Methodology	17
3.1	Research Design	17
3.1.1	Qualitative Methods	17
3.1.2	Quantitative Methods.....	18
3.2	Sampling Technique.....	19
3.3	Sample Groups for Purposive Sampling.....	19
3.3.1	Smallholder Farmers.....	19
3.3.2	Insurance Providers	19
3.3.3	Government Officials.....	20
3.3.4	Agricultural Experts	20
3.4	Data collection.....	20
3.4.1	Farmers.....	20
3.4.2	Agricultural Insurance Companies	21
3.5	Variables.....	21
3.5.1	Dependent Variables.....	21
3.5.2	Independent Variables:	22
3.6	Data Analysis.....	22
3.1.1	Quantitative Data Analysis	23
3.1.2	Qualitative Data Analysis.....	23
3.1.3	Triangulation.....	23
3.7	Ethical Considerations	24
3.8	Limitations.....	24

4.0 Chapter 4: Analysis and Results	25
4.1 Qualitative and Quantitative Analysis	25
4.1.1 Frequency Tables and Charts.....	26
4.2 Quantitative Conclusion.....	31
4.3 Qualitative Analysis	32
4.3.1 Approach to Qualitative Analysis.....	32
4.4 Summary of Findings	32
4.5 Thematic Analysis.....	33
4.5.1 Effectiveness of Risk Assessment Methods.....	33
4.5.2 Adequacy of Insurance Coverage.....	33
4.5.3 Role of Technological Innovations	34
4.5.4 Difficulties of the Policy and Regulation Surrounding	35
4.5.5 Impact of Agricultural Insurance on Livelihoods	36
4.5.6 Barriers to Insurance Adoption	36
4.5.7 Recommendations for Improvement	37
4.6 Summary of Qualitative Findings	38
5.0 Chapter 5: Discussion.....	39
5.1 Effectiveness of Risk Assessment Methods	39
5.2 Adequacy of Insurance Coverage	39
5.3 Impact of Technological Innovations.....	40
5.4 Challenges in the Policy and Regulatory Framework	41
5.3 Impact of Technological Innovations.....	41
5.4 Challenges in the Policy and Regulatory Framework	42
5.5 Impact on Smallholder Farmers	42
5.6 Barriers to Adoption and Recommendations.....	43
5.7 Limitations of the Study	44
5.8 Future Research Directions	45
6.0 Chapter 6: Conclusion	47
Reference	49

Appendices.....	52
Appendix A: The Missing Market of Crop Insurance in Kenya - IEA Kenya.....	52
Appendix B: Innovative Approaches towards Agricultural Risk Management	52
Appendix C: Kenya: Agriculture Insurance Solutions Appraisal.....	53
Appendix D: Risk Management Effects of Insurance Purchase and Organization in Agriculture.....	54
Appendix E: Agriculture risk management and role of insurance	55

List of Tables

Table 1 The importance of risk management in agricultural insurance as perceived by farmers	27
Table 2 Insurance companies' views on the sufficiency of current agricultural insurance coverage .	27
Table 3 Farmers' awareness of agricultural insurance products	28
Table 4 Farmers' perception of the adequacy of insurance coverage	29
Table 5 Farmers' satisfaction with current agricultural insurance services	29
Table 6 Perceived impact of agricultural insurance on farming activities.....	30
Table 7 Adoption rate of technological innovations in agricultural insurance.	31

List of Figures

Figure 1 Insurance companies' views on the sufficiency of current agricultural insurance coverage.....	28
Figure 2 Farmers' satisfaction with current agricultural insurance services.	30
Figure 3 The Missing Market of Crop Insurance in Kenya - IEA Kenya.....	52
Figure 4 Innovative Approaches towards Agricultural Risk Management.....	52
Figure 5 KENYA: AGRICULTURE INSURANCE SOLUTIONS APPRAISAL.....	53
Figure 6 Risk Management Effects of Insurance Purchase and Organization in Agriculture	54
Figure 7 Agriculture risk management and role of insurance.....	55

1.0 Chapter 1: Introduction

Agriculture stands as a vital sector for many economies worldwide, playing a crucial role in food security, poverty alleviation, and economic growth. However, the sector faces various complex issues, and that is why there is a need to work on the management of risks, such as through agricultural insurance (Alston & Pardey, 2014). In Kenya, the majority of farming is rainfed; this makes agriculture in the country extremely weak due to the impacts of climate change and erratic weather conditions. Unpredictable weather conditions, for instance, drought, which fails in crop production, are among the deadliest threats to agricultural personnel. Pests and diseases act as other challenges that are made worse by the growing climatic conditions; all these challenges affect the farmers (Kogo et al., 2021). Market risks are another aspect that increases fluctuations, affecting farmers' income and financial security.

Agricultural insurance emerges as a promising tool to mitigate these risks and enhance farmers' resilience. In offering a cushion against potential risks, including crop failure occasioned by weather risks or pests and diseases, agricultural insurance insulates farmers against revenue loss, thus facilitating investment in better agricultural practices and technologies (Robles, 2021). It can also help in the provision of credit, either as security for production inputs and equipment, so that farmers can borrow to finance productivity-enhancing inputs and technologies. However, the utilisation of agricultural insurance among the farmers in Kenya remains limited due to the low awareness of the available products; accessibility and affordability of the products are some of the factors that act as barriers to insurance uptake among the farmers (Kramer et al., 2022). In addition, the low insurance density and the problems with risk assessment erode the potential of the existing insurance activities. Solving these difficulties requires the cooperation of various fields, including governmental organisations, insurance companies, banks or credit facilities, and agricultural extension services. Some measures that would enable expanding the application and effectiveness of agricultural insurance in Kenya include steps towards raising awareness of the importance of agricultural insurance, as well as the creation of cheap and more accessible insurance products for farmers and adjustments in the existing methods of assessment of risks (Nshakira-Rukundo et al., 2021).

1.1 Background Information on Agricultural Insurance in Kenya

The Kenyan government's efforts in advocating for the uptake of agricultural insurance as a hedge against the likely effects of climate change and other social risks reflect an understanding of the

importance of agriculture in the economy and food basket of the country. As much as the government and private insurers continue to intervene and promote the development of agricultural insurance for various crops as well as the different states of the country, there are still some barriers that need to be overcome in a bid to ensure high uptake by the smallholder farmers. A major barrier towards the adoption of agricultural insurance is the reduced availability that many smallholders continue to face (Ndung'u, 2010). Such farmers can perform their activities in isolated or less progressive areas, which may make it difficult for insurance services to penetrate because of deficiencies in infrastructure or inadequate publicity. Moreover, they have many barriers; for instance, administrative procedures that farmers follow to gain insurance coverage are cumbersome and discourage the farmers from joining such schemes.

In addition, issues that pertain to the ugliness of the insurance premiums pertain to a major issue among the smallholder farmers with limited incomes and operating on a tight, narrow margin between cost and income. The premiums depend on the costs of coverage, while the benefits, according to farmers, are not always convincing, as it is financially unviable for most farmers to go for agricultural insurance during a period of economic or crop' failure. Further, it is worth noting that the current insurance products available in the market are unable to meet the farmers' requirements in terms of coverage and suitability, which has deepened the low uptake of agricultural insurance in Kenya (Justus, nd). Most insurance systems require the coverage of various hitches like post-harvest, price disasters, and diseases across the farmer's sector, hence contributing little to eliminating risks in agriculture.

To solve these issues, new concepts should be applied to make agricultural insurance more available, inexpensive, and efficient. This may include using mobile apps for insurance enrolment and claims and using satellite imagery and remote sensing for better risk modelling and timely compensation. Moreover, smart financial bonuses and subsidies may ultimately contribute to lower insurance costs across the board for smallholder farmers, as would clear insurance products and easy claims procedures within the sector, thus increasing its attractiveness to members of the agricultural community (Baagøe et al., 2020). By eradicating these barriers and adopting new ideas and opportunities in the progression of Kenyan agricultural insurance, the farming community's food security as well as the development and growth of Kenya's agriculture sector will greatly improve.

1.2 The Role of Risk Assessment and Coverage for Innovations in Agricultural Insurance

Agricultural insurance is the core of the matter while it secures the lives of the farmers amidst the ups and downs of production in agriculture. The efficiency of such type of protection is determined by its ability to forecast risks and, accordingly, bring universal coverage. This strategy of risk assessment and coverage together builds the scheme of insurance to meet farmers' needs, which renders the product feasible and usable (Jepchumba, 2015). Agricultural insurance undertakes the issue of risk assessment via the meticulous study of variables that could be hazardous to the crops' health. They spill over to such things as unpredictable weather patterns, increased pest infestations or outbreaks of diseases, market fluctuations, and other chances of uncontrollable changes. Through the use of advanced methods like satellite imagery and weather forecasting models, insurance companies obtain the key information on circumstances that affect the risks and, therefore, can pinpoint them more precisely, which results in a better assessment of risks. This, as a result, deepens the financial stability of insurance as it smooths the premiums by eliminating the losses arising from extreme weather events.

A comprehensive policy covering a variety of risks is necessary in addition to an effective risk assessment that can shield farmers against a broad range of threats. Financial risks of agriculture should be covered by the insurance product with a wide range of risks, including crop failure, and other incidents (Lorant, & Farkas, 2015). Farmers feel that they can count on insurance coverage whenever they face such hardships. Insurers, hence, take the responsibility to cover the risk and contribute to the insurance safety net, thus increasing the product's credibility and gearing more players toward the product.

Inventions are vital not only to improve agricultural insurance but also to beat the old constant obstacles. Breath-taking technological innovations such as remote sensing of plant growth for schedule development, complicated weather forecasting algorithms, as well as mobile payment systems, considered the next step in a cash-free economy, play a great role in transforming the insurance sector (Cole, & Xiong, 2017). Frequently, these inventions discover the significant risk of a particular product yet only influence the design, distribution, and claims process of the products. Besides, the mentioned technologies raise barriers such as data scarcity and high transaction costs to the minimum. In addition, the agricultural insurance services are targeting a larger demographic and it has become accessible and affordable to farmers.

1.3 Research Problem Statement

Despite the potential benefits of agricultural insurance and innovations in enhancing risk assessment and coverage, significant challenges persist in the Kenyan context. More empirical evidence is needed regarding the effectiveness of current risk assessment methodologies, the adequacy of insurance coverage, and the impact of technological innovations on agricultural insurance uptake and performance. Moreover, more needs to be understood about how various factors, including socioeconomic, institutional, and environmental, influence farmers' decision-making regarding insurance adoption and utilization.

1.4 Objectives of the Study

The primary objective of this study is to assess the effectiveness of agricultural insurance innovations in Kenya, with a focus on risk assessment and coverage. Specific objectives include:

1. To evaluate the existing agricultural insurance landscape in Kenya.
2. To analyse the coverage provided by existing agricultural insurance products and identify gaps in coverage.
3. To explore innovative approaches to agricultural insurance that can better meet the needs of smallholder farmers.

1.5 Research Questions

1. What is the current status of agricultural insurance in Kenya?
2. How effective are existing risk assessment methodologies in the context of agricultural insurance?
3. What innovative approaches can be adopted to improve agricultural insurance coverage for smallholder farmers?

1.6 Significance of the Study

The study will have significant implications for a range of stakeholders in Kenyan agricultural development and risk management, consisting of insurers, farmers, and other key players in agriculture. The research thus brings to light the difficult issues and opportunities in the agricultural insurance arena. Informing lawmakers through informed policymaking and strategic actions about this field of activity is a key product of this research. The research provides policymakers with empirical results to construct policies better suited to prop up the majority of the agricultural insurance demand and sustainability. Knowing that the farming and insurance sector faces specific challenges

in Kenya can be a way of shaping policy initiatives to ensure people in the agriculture sector enjoy a better environment for insurance schemes to grow.

Insurers can leverage the obtained knowledge through research to realize the prospects of more efficient client acquisition, deeply understanding the requirements and preferences of agricultural clients and the barriers that limit the wide insurance products' spread. Insurers, here armed with their knowledge, must improve their contributions and devise inventive solutions that will be able to fit farmers' demands better. This study has an advantage to the farmers who will use it to identify the key features of agricultural insurance apart from the factors that go into the decision-making process when regarding insurance uptake. The approach of addressing the concerns of credible farmers and making insurance affordable and relevant results in the study makes an important contribution to the reduction of vulnerability of agriculture systems against a range of risks, and this results in farmers ultimately having improved livelihood and enhanced food security.

This research connects with the Sustainable Development Goals (SDGs), particularly the first goal (SDG 1) - No poverty, the second goal (SDG 2) - Zero Hunger, the eighth goal (SDG 8) - Decent Work and Economic Growth, and the last goal (SDG 13) - Climate Change Action. This is achieved by strengthening the resiliency of smallholder farming and enhancing sustainability and inclusiveness in the agricultural sector; thus, these findings support the sustainability agenda of the development in Kenya as a country and the world in general (Warner, et al., 2013). By putting forward its theoretical and empirical insights properly, this study will help in the dissemination of knowledge as well as building capacity that is critical in agricultural economics, risk management, and development studies. Through its papers, policy briefs, workshops, and conferences, the study spreads information that enables knowledge transfer and capacity building among different participants of agricultural insurance and risk management programs, such as experts, practitioners, and policymakers. As a result of this, there will be a prominent establishment of research and a policy system that will work towards the growth and development of agriculture in Kenya and related contexts.

Additionally, the academic community will gain from the research by enriching theoretical frameworks, methodologies, and empirical results on risk assessment, coverage, and innovations in agricultural insurance (Prokopchuk, et al., 2018). The article will contribute to the literature in academia that will stimulate dialogue and knowledge exchange and create a platform for future research, which would include additional studies concerning the agriculture insurance dynamics in Kenya and other countries.

1.7 Structure of the Thesis

The thesis is divided into five chapters, and each chapter is dedicated to a particular aspect of the research area. Chapter 1 introduces the research topic by providing background information, explaining the importance of the study, defining the research problem, and giving the objectives as well as the structure of the thesis. Chapter 2 provides a literature review on agricultural insurance, risk assessment, coverage, and innovations, which presents the research gaps that will be filled in this study. Chapter 3 looks at the research methodology, such aspects as the research design, data collection procedures, sampling techniques, data analysis, considerations of ethics in research, and strengths/limitations of the study. Chapter four of the study usually presents the result of the study, often in the form of data and/or statistics and/or graphs or tables that were analysed earlier. Lastly, Chapter 5 provides the discussion and conclusion and policy implications for policymakers, insurers, and other relevant authorities and future research avenues.

2.0 Chapter 2: Literature Review

The literature review section gives an extensive discussion of the current agricultural insurance situation in Kenya with emphasis on theory, evaluation of risk and coverage in the agricultural sector. It looks at the background and advancement of insurance services, explores the farmers' and insurers' obstacles, and assesses the insurance demand factors. Using credible sources of information, the review also sets out new product development and innovations for instance index-based crop insurance and mobile-based platforms in addition to outlining the regulatory framework and policies influencing the sector. Therefore, this analysis provides the context in which the prospects and potential of improving agricultural insurance to build the resilience and sustainability of the Smallholder Farmers' Agricultural Alliance (SFAA) platform for smallholder farmers can be appreciated.

2.1 Theoretical Framework

Agricultural insurance is one of the best ways through which risks affecting agriculture can be dealt with, especially in countries such as Kenya which is experiencing increased cases of climate change. To explore the effectiveness of agricultural insurance innovations in Kenya, this study draws upon three key theoretical perspectives: These are Risk Theory, Diffusion of Innovations Theory, System Theory. These theories give a lucid structure for the evaluation of threats, insurance and prospects of innovative solutions in the agricultural industry.

Risk theory is at the heart of programming how agricultural insurance works because it is devoted to measuring and regulating the extent of risks in farming. For farmers, there is always uncertainty in weather conditions and crop menace such as pests' infections and fluctuating market prices (Komarek et al., 2020 pg 76). This theory is adopted by insurers who evaluate the chances of such incidents and the likely effects in creating policies that enable them to shift such risks from farmer's insurers. As seen in Kenya where smallholder farmers are most vulnerable to climate-related shocks, risk theory is useful in shading designs that enable the development of affordable and effective insurance coverage that minimises the insurers' risk exposure to extremely vulnerable events.

The Diffusion of Innovations Theory also helps the understanding of how new agricultural insurance products are adopted by smallholder farmers (SHFs). This theory helps to understand how innovations including weather-indexed insurance or mobile-based insurance access frame the user populations, including the farmer populations (Montes et al., 2021, pg 139). The analysis of these key factors has it that whether farmers will embrace insurance products or not depends on the level of

perceived benefits, ease and flexibility of the products. This is especially important in the Kenyan context where the target insured population of smallholder farmers may not necessarily be conversant with formal insurance products and or services.

This research aims to show that an application of the systems approach can effectively present a wide systemic context in which agricultural insurance actors function based on their interdependencies with one another. The conclusion that can be made regarding agricultural insurance is that this product or service is provided within a complex environment, and thus cannot be effective without the support of different actors. For instance, the governments, the markets and other factors such as climate change affect the functioning of insurance products. In Kenya, such an approach helps to understand the specifics of interaction between these elements and defines areas for increasing the coverage and effectiveness of agricultural insurance.

The use of these theories presents how the dynamics of change exist about agricultural insurance innovations in Kenya. Instead, risk theory is directly practiced by quantifying probabilistic models of the occurrence of certain events such as droughts and floods, so that insurers can come up with index-based insurance products that pay out whenever there are specified weather conditions (Tinh et al., 2021, pg5). This saves time and makes the whole process of identifying and submitting claims easier for both the farmers and insurers. At the same time, the theory of diffusion of innovations offers an understanding of the growth of usage of mobile-based insurance services by Kenyan farmers, being satisfied with the opportunities that allow them to obtain relevant information in time. The dissemination of information and awareness creation, and relating to early adopters are important in the use of these innovations.

As per systems theory, this study looks at the bigger picture of agricultural insurance and finds out the market gaps and opportunities for intervention to ensure that insurance gets closer to the smallholder farmers (Llewellyn, et al., 2020, pg 112). For instance, constrained infrastructure or lack of weather information can be a blander to insurance products. Thus, this approach pointing out the whole system demonstrates how different actors could fill the above gaps to enhance development of inclusive insurance.

Overall, the study finds that the confluence of risk theory, diffusion of innovations theory, and systems theory provide an appropriate theoretical model for understanding the assessment of agricultural insurance innovations in Kenya. All theories help to enhance insight into the risk management process, the innovation diffusion process and the enabling/disabling environment provided by the whole system of agricultural insurance. All these theories, therefore, inform the assessment of the

current insurance solutions and the generation of potential new solutions to improve services for smallholder farmers.

2.2 Historical development and evolution of agriculture insurance in Kenya

The development in agricultural insurance in Kenya within the past few years has been because of the realization of its importance, and for this reason, the farmers will be more resilient to climate and market uncertainties. The Ministry of Agriculture, Livestock, Fisheries, and Cooperatives laid out the National Agricultural Insurance Policy (NAIP) as the national approach to the development and taking up of agricultural insurance by the entire country's citizens (MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES, AND COOPERATIVES, 2021). While significant headway has been made regarding the advent of agricultural insurance schemes, several challenges remain. This means new approaches to risk assessment are required for efficient risk evaluation (Warner et al. 2013). When the country targets solutions to these issues, the agricultural sector is strengthened; farmers enjoy better food security while coping with new environmental and market settings.

2.3 Risk Assessment in Agriculture Insurance

2.3.1 Risk faced by insurance sectors

i. Climate Risks

Climate risks are a major concern in agricultural insurance, especially in Kenya, where agriculture heavily depends on weather patterns. According to Mugo et al. (2020), frequent and unpredictable weather events such as droughts and floods pose significant challenges to farmers, necessitating robust risk modelling and accurate meteorological data, to forecast and mitigate these risks effectively. The study emphasizes the need for advanced analytical tools for predicting climate variability on agriculture, which is crucial for designing insurance products that accurately reflect the risk landscape (Mugo et al., 2020).

ii. Moral Hazard and Adverse Selection

The problems of moral hazards and adverse selection are vital and have a great hindrance to the efficiency of agricultural insurance. Kinyanjui (2018) brings out the fact that moral hazards arise when farmers engage in risky agricultural practices, assuming insurance, which could lead to increased frequency and severity of claims. However, on the negative side, the pattern of adverse selection is

that those farmers who perceive higher personal risk, such as those facing natural disasters, any kind of calamity, or sudden diseases, will be more inclined towards purchasing insurance, which could subsequently lead to skewed risk pools and higher premiums (Kinyanjui, 2018). Some remedies that might cover these challenges are effective underwriting and premium pricing strategies.

iii. Regulatory and operational risks

Policies and regulatory amendments introduced by the government could have a large effect on the agricultural insurance environment. Nyawira and Wang'ombe (2019) analyze the effect of regulatory risks in terms of pricing, terms, and position of insurance products in the market, stating that, the operational risks, which include distribution, management, and administration difficulties in insurance schemes, especially in remote areas with poor infrastructural set-up, are crucial for the outcome and effectiveness of insurance schemes.

iv. Technological and market risks

The dependence on technology for data gathering and risk analysis exposes technical vulnerabilities to systemic disruptions. Accepting satellite imagery and other technical instruments to assess risks on agricultural landscapes is important, but it may be interrupted or could provide wrong data, leading to a compromised risk assessment (Chebet, 2021). Apart from that, the market fluctuates between farmers who have a higher demand for insurance in good economic climates and a lower demand when economies deteriorate, therefore, undermining farmers' awareness about insurance. This is a risk that insurers need to manage well to keep their consumer base strong and their companies financially stable (Chebet, 2021).

2.3.2 Risk faced by farmers

i. Climate Risks

Farmers' issues are predominantly often the risks related to climate change, especially for a country like Kenya that has an agriculture that is highly dependent on rainfall. The risks of extreme weather events, especially droughts and floods, to small farms are too often ignored. Perennial floods cause crop destruction, and soil erosion, thus resulting in the reduction of the farmers' economic security. These events not only cause the immediate loss of agricultural produce but also reduce long-term productivity, and lower soil fertility and water availability, requiring farmers to reconstruct and adapt their planting schedule by changing their crop selection. These adaptation strategies, such as employing drought-tolerant crops and advanced water management systems, are sine qua non, in

most cases, needing huge financial input primarily from governmental and non-governmental bodies (Mugo et al., 2020).

ii. Market Volatility

Market uncertainties are defined by dramatic changes in price for farm produce that are influenced by a range of aspects, among many, being shifts in supply and demand, global economic conditions, and trade policies. This instability can be the main reason for farmers getting lower incomes at other times when they cannot sell their products at cost-worthy prices or if the cost of input rises too rapidly. Unpredictability often makes things difficult for farmers, making it hard for them to accurately plan and budget, increasing financial instability likelihood. Beyond that, small-scale farmers usually reap fewer gains since they are in a weak market position and often cannot exert great bargaining power to affect prices, especially when markets are switching. They should focus on formulating and utilizing cooperative societies to secure their employment rights (Chebet, 2021).

iii. Pests and Diseases

Heightened rates of pests' invasion and disease outbreaks tend to be favoured by environmental changing conditions thereby remaining a continuous detriment to crops. These risks are postulated to bring losses if their damage to the agricultural sector is fought back soon and properly. The diffusion of pests and diseases generally is influenced by factors, that are difficult to forecast in advance, which makes prevention and control more complex. The adaption of integrated pest management techniques based on the use of environmentally friendly pesticides with crop rotation and introducing natural enemies are key practices to be effective in the management of this risk. Besides access to prompt details and technical back-up, the farming community is also required to achieve the same. (Omondi, 2017).

iv. Inadequate Insurance Coverage

Many farmers struggle with the inadequacy of insurance coverage, which often fails to encompass all the risks they face, such as post-harvest losses and specific localized perils. This limitation can leave farmers vulnerable to financial distress in the event of unforeseen adversities. Protection from specific risks related to agriculture, and insurance products that meet the standards of the agricultural sectors are fundamental to creating a safe financial environment. In addition, one would have to also develop creative insurance models, such as index-based insurance (sometimes referred to as early warning systems), that assist based on a certain value of the predetermined g-index. The demography of the region where these farmers and farm workers live should be examined to

determine if they are prone to high levels of rainfall (Rainfall intensity), which may cause the loss of crops (Omondi, 2017).

2.3.3 Differences Between Risk Management and Insurance

Effectiveness

Analyzing agricultural risk management and insurance effectiveness, the two concepts have different objectives, approaches, and focus. Risk management is naturally preventive in its orientation, focusing on avoiding or reducing risks where possible. It encompasses predictive analytics incorporating complex risk models, crop segregation, and the use of hardy management techniques on weather, pests, and diseases (Mwangi et al., 2022). However, insurance effectiveness is reactive; it aims to offer financial relief only after the risk has materialized. Ultimately, it aims to facilitate quick recovery of farmers from losses, and these should be covered quickly (Glauber et al., 2021).

Risk management and insurance effectiveness are two entities that vary in different ways. Risk management has several approaches to taking preventative measures, such as using technology like satellite imagery and weather sensors to do a threat assessment and reduce the exposure (Jepchumba, 2015). These actions are not bound to insurance only and therefore can range from implementing sustainable farming techniques to adopting drought-resistant crops (Baagøe et al., 2020). Conversely, insurance efficiency focuses on developing the appropriate insurance products to cater to specific needs for the farmers. For instance, index-based insurance, which uses intended ranges of precipitation levels, is more effective because it provides prompt compensation and decreases the cost of claims administering (Kramer et al., 2021).

Furthermore, each concept is distinguished by its focus. The risk management is a comprehensive cover ranging from a wide spectrum of strategies for protecting the farmers from a number of potential risks, whether financial, environmental, or market-based (Lorant and Farkas, 2015). On the contrary, insurance effectiveness is more limited, focusing on the extent and adequacy of insurance products and tools used to manage the identified financial risks. While risk management offers the basis of sustainable agriculture, insurance effectiveness maintains economic variability by fulfilling missing links in the layer of financial protection (Baagøe et al., 2020). Together these complementary approaches can make a significant contribution to the stability and productivity of the agricultural sector.

2.4 Coverage Analysis in Agriculture Insurance

2.4.1 Index-Based Crop Insurance Services

According to Osumba et al. (2020), which is a scoping study, research on the status of index-based crop insurance services in Middle-East Africa, including Kenya, Tanzania, and Uganda, is done. Identifying the most noticeable drawbacks and bottlenecks in index-crop insurance was one of the indications made from the study. A list of problems arises, including a low level of knowledge among farmers, insufficient understanding, inaccurate collection of data, and formulation of the index. Nevertheless, the research also highlights the challenges upcoming in the application of index-based insurance, but it also brings to the fore the efficacy of such measures in mitigating agricultural risks, more so in areas that are prone to climatic shifts. Researchers and development practitioners have proposed several promising methods to dislodge East African agriculture from the trap and uncertainties posed by weather and the environment. One of the approaches is to offer insurance to farmers by hedging the unpredictable weather patterns and other environmental uncertainties. Solving the difficulties is key to the increasing adoption and performance of these insurance tools, therefore contributing to the category's improved livelihoods and food security.

2.4.2 Determinants of Uptake and Strategies for Improvement

Nshakira-Rukundo et al. (2021) provided an assessment of the determinants of insurance uptake together with the relevant strategies to stimulate its popularity in the entire continent. The research also highlights the complex nature of factors that make farm owners choose or not to go for insurance, which could be social and economic status, access to information and trust in insurance organizations, and risk perception. The authors point out that these factors are those that affect the adoption of insurance, so innovations should be custom-made to mitigate the barriers. They recommend a variety of target interventions ranging from financial literacy programs, which contribute to improving farmers' grasp, efficient mechanisms for information dissemination to help farmers understand better, and innovative distribution channels for enabling access. The design goes beyond the adoption of agricultural insurance. Indeed, the study's purpose is to find the key ways of rooting out the barriers to insurance coverage expansion in African farming communities. This will make productive engagement safer and help farmers protect their livelihoods against the vagaries of nature and market volatility.

2.4.3 Reliable Adoption of Crop Insurance

Baagøe et al. (2020), researched the uptake of crop insurance in Kenya and considered the multitude of economic variables that drive farmers' decision-making processes. The research permeates the curtain, covering the critical factors pointing farmers in one direction or another. Immersion of the aspects of premium payment affordability, identified benefits of the insurance cover, trust in insurance institutions, or availability of extension services is an important element that shall be carefully analysed in the course of the study. It will reveal the key factors shaping farmers' willingness towards insurance adoption. The above findings, therefore, do not only point towards the need for targeted policies that enhance awareness of existing insurance organizations but also, refining agricultural insurance products and overcoming financial challenges facing smallholder farmers. Policymakers and stakeholders can engage better with crop insurance as a mechanism to deal with these key aspects, and this working together will help to create a more conducive environment for wide acceptance of crop insurance by Kenyan farmers, thereby increasing resilience and sustainability in the farming sector amidst risks associated with agriculture.

2.5 Impact Evaluation of Agriculture Insurance Programs

Jepchumba (2015), in her dissertation, assessed the performance of large-scale maize farmers in Kenya using corn crop insurance. The research aimed to classify agricultural insurance as a risk management tool and further analyse how it affects farmers' income level, food stability, and especially the resilience to uncertainties related to agricultural production. The study that was carried out was very patient, and it carefully examined the practical outcomes of insurance adoption concerning the maize farming sector within Kenya (Kramer et al. 2021). The study provided unmatched knowledge about how agricultural insurance manifests in the Kenyan market. Through empirical data and qualitative analysis, Jepchumba's research will likely illuminate the intricate ways in which insurance mechanisms influence decision-making processes, investment patterns, and the livelihoods of farmers, guiding policy-making efforts and designing sustainable agricultural development strategies adapted to the needs of smallholder farmers in Kenya and beyond.

2.6 Regulatory Framework and Policy Environment

The regulatory framework and policy environment are critical components for the effective implementation of agricultural insurance in Kenya. Recent developments include the National

Agricultural Insurance Policy (NAIP), which aims to promote and regulate agricultural insurance to enhance resilience and sustainability in the farming sector (MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES, AND COOPERATIVES, 2021). This policy is part of a broader strategy to integrate risk management tools into the agricultural sector to mitigate the impacts of climatic and market uncertainties. Effective policy and regulation not only provide a structured approach to managing risks but also ensure that insurance products are accessible, affordable, and adequately meet the needs of farmers. This framework supports the agricultural sector's growth by creating a stable environment that encourages investment and innovation in agricultural insurance.

2.7 Innovations and Emerging Trends

Hess et al. (2016) spotlight agricultural insurance innovations and emerging trends such as using remote diagnosed satellite, mobile-based platforms, and remote sensing techniques to deliver insurance and file claims. The developments, despite the high transaction costs, improvement of risk assessment level, and insurance reach to small-scale farmers, envision a new era in insurance. However, these improvements have their shortcomings that can be addressed by ensuring the smooth process of integrating them into the existing insurance structure and seeing to it that the indigene groups get equal access to their provisions. Overcoming these challenges requires coordinated actions to fill existing digital gaps, establish multi-stakeholder cooperation policies, and align them with a sense of national interests and pride. These barriers may be viewed as opportunities arising out of them and could make the agricultural insurance sector a key factor in supporting resilience, food security, and sustainable development in rural areas globally.

2.8 Challenges and Opportunities

Kramer et al. (2021), in their extensive literature, give a scientific perspective of Consultative Groups on International Agricultural Research (CGIAR). The work not only presents the gains they have accomplished but also exposes the research areas that need to be given attention in future work regarding agricultural insurance innovations. The core of their talk business is to do specially designed insurance products appropriate to the needs of each small-scale farmer not only in Kenya but also in other developing countries around the world. The authors illustrate the indispensable role of research in policy-making, thus expediting the acceptance of the innovative mechanism of insurance as a means of beefing up the existence of resilience in the agricultural sectors. Thus, elaborating on the sensitivity of insurance policy to context, the write-ups recommend taking into account local ground realities to ensure that the risks are mitigated. By bringing this puzzle together

in a piece, they bear the truth of this harmonious nature between research, policy, and community empowerment, thus pointing the way to the exponential development of businesses in agricultural backyards.

The literature review presents essential details on current agro-insurance in Kenya, addressing the state of risk assessment and coverage as well as opportunities to improve the area. Noting the introduction of index insurance as well as now the development of various unique types of insurance, all to address the risks that are related to agriculture, the resilience of agricultural communities is becoming more evident. Comprehensive efforts are necessary to deal with roadblocks towards insurance take-up and improve scheme effectiveness, ensuring smallholder farmers to policy design. The overview presented hereafter will pave the way for subsequent chapters of the thesis that will discuss in detail various aspects of agricultural insurance risk analysis, coverage, and innovation in Kenya.

2.9 Summary

The literature review highlights the critical role of agricultural insurance in managing risks faced by smallholder farmers in Kenya, particularly in the context of climate change and market volatility. It draws upon key theoretical frameworks such as risk theory, diffusion of innovations, and systems theory to explain the dynamics of insurance adoption and coverage. The review addresses the various risks faced by both insurers and farmers, including climate risks, moral hazards, adverse selection, and technological vulnerabilities. Furthermore, it explores emerging trends in agricultural insurance, such as index-based products and mobile platforms, alongside the challenges of regulatory frameworks and policy implementation. Overall, the literature reveals gaps in insurance coverage and underscores the need for innovative solutions to enhance insurance adoption, improve risk management, and support smallholder farmers in building resilience.

3.0 Chapter 3: Methodology

3.1 Research Design

The research design used in this study is the concurrent mixed methods approach that combines both qualitative and quantitative data collection and analysis techniques to offer an all-round approach to the risk assessment and coverage analysis for the innovations in agricultural insurance in Kenya (Dawadi et al., 2021). Dawadi et al. (2021) used surveys, qualitative observations, and interviews with key informants to ensure the range, comprehensiveness, and complexity acknowledged in the mixed-methods approach. This data collection method is particularly helpful in data triangulation where the reliability and accuracy of the research results are enhanced (Bans-Akutey & Tiimub, 2021). In my research, this approach will be used to analyse the quantitative results and use the narrative results to afford this judgement of how effective and difficult it has been in the agricultural innovations in insurance. This approach of data collection facilitates for the data gathered to be verified from several sources hence enhancing the quality of the research outcomes.

3.1.1 Qualitative Methods

In-depth Interviews: Baagøe et al. (2020) used a qualitative research method to interview participants in detail to gain detailed information about crop insurance in Kenya. This procedure is one of the face-to-face interview methods that enable the researchers to get a better understanding of the stakeholders' impressions and communication activities on agricultural insurance innovations in Kenya. Perspectives of the smallholder farmers, insurance firms, government officials and farmers are both relevant because they provide information about a round of challenges facing the sub-sector (Baagøe et al., 2020). When questioning the participants and paying attention to the answers received, researchers are to get good material; at times, it may even be difficult to measure with figures and numbers. Similarly, interviews help discover basic background information that would help explain factors that define success in the utilization of agriculture insurance.

Focus Group Discussions (FGDs): Yulianti and Sulistyawati (2021) employed the OFGD model for learning, where Online Focus Group Discussion (OFGD) was used. In my research, this method will facilitate virtual discussions with Kenyan farmers to gather insights on agricultural insurance. FGDs allow farmers, along with insurance companies that offer agricultural insurance solutions, to have a chance to discuss their opinions, concerns, and feelings about the mentioned service (Yulianti & Sulistyawati, 2021). Bringing the various stakeholders to a representational group for research and

controlled words and actions allows the researchers to see, discuss, and distinguish the variations within the contexts of the selected community. FGDs include a brainstorming process through which participants interact and add information, concepts, or ideas to each other (Yulianti & Sulistyawati, 2021). This method not only produces rich qualitative data to aid analysis but also fosters participation and empowers the community, potentially resulting in more sustainable and innovative agricultural insurance policies and programs in the future in the Kenyan context.

3.1.2 Quantitative Methods

Survey Questionnaires: Karanja (2011) used survey questionnaires to assess the impact of financial innovation on the growth of insurance companies in Kenya. Similarly, we will use this method to evaluate agricultural insurance adoption. Surveys conducted using standardized techniques like questionnaires provide methodical means to gather quantitative data on the aggregation, coverage, and efficiency of implemented agricultural insurance products among the farmers, using a sampling representation across the target population. Variables such as awareness, purchase intention, perceived risks, and financial status can be effectively measured using survey instruments in the context of insurance. Surveys offer valuable self-reported data, which, when subjected to statistical analysis, allow for the evaluation of distribution patterns, as well as the identification of associations and differences related to participants' demographic characteristics and geographic location (Karanja, 2011). More critically, surveys provide important data on the extent and impacts of agricultural insurance measures that can be crucial for policymaking on program initiatives as well as funding for Kenya's smallholders. Usually, these surveys employ a 5-point Likert scale to measure responses that include strongly disagree, disagree, neutral, agree, and strongly agree, thus providing a broader view of how the target respondents perceive some factors or issues (Joshi et al., 2015).

Secondary Data Analysis: Secondary analysis involves the use of data gathered through other research and documents. That is why the researchers can use government reports, academic journals, and insurance databases alongside their findings. It also allows a broader evaluation of historical backgrounds and environments in which relevant institutions, rules, and regulations have emerged and evolved, as well as of the performance indicators of agricultural insurance in Kenya. A feature of such an approach is the expansion of the field of vision, which allows for the analysis of complex causal connections between variables that characterize insurance and its changes in time. Secondary data also have certain advantages and disadvantages, including the validity and reliability of the research findings as well as playing a crucial part in the triangulation method, which makes this research study more stringently executed (Bans-Akutey & Tiimub, 2021).

3.2 Sampling Technique

To ensure the targeted participants are knowledgeable and actively participating in the agricultural and insurance sectors, purposive sampling will be used. As a result, the recruitment of participants specializing in such sectors minimizes the possibility of discrepancies between the expected set of data and the research goals, as the collected data is believed to provide a rich and relevant information set. Since purposive sampling focuses on capturing participants' viewpoints, its application helps the researcher obtain essential and detailed information regarding the complex environment, issues, and prospects of the agricultural and insurance sectors (Rutere & Kori, 2023). This reduces the risk of conducting irrelevant and abstract research while providing the best results for the targeted sectors. Regarding the data amount, using the principle of data saturation, the required sample size will be reached, which will eliminate the redundancy of the collected data. This implies that the acquisition of extra data will stop once it is determined that further data collection will not yield much more findings in the study, meaning that the study will be very productive and useful.

3.3 Sample Groups for Purposive Sampling

3.3.1 Smallholder Farmers

Smallholder farmers are the backbone of global agriculture, representing diverse regions and crop types. They are usually faced with restricted capital and come across several constraints, such as unfavourable climate changes, diseases, floods, and uneven prices for their produce. They play a very important role in providing food for communities and households, and yet they are exposed to so many risks that can see them knocked down from their source of income (Muyanga & Jayne, 2014). These risks, if not well covered, can deter them from investing in their farms, reduce productivity, and not support their families well. Affordable and reliable agricultural insurance can help them overcome these risks.

3.3.2 Insurance Providers

Insurance providers, both in the private and public sectors, play a critical role in offering agricultural insurance to smallholder farmers. Private players provide the state-of-the-art technologies and efficiencies needed in this business while targeting a particular demand from farmers. Automotive insurance is typically underlaid by public markets, in which governments intervene to assist markets in areas where markets cannot provide sufficient products by offering subsidies or reinsurance to increase the availability of insurance (Ndung'u, 2010). There is huge potential for symbiosis between

public and private insurers, as they both aim to deliver protection to farmers across the world and also need to be sustainable in the long run and avoid any systematic risks to the industry.

3.3.3 Government Officials

Government officials from departments such as agriculture and finance are instrumental in creating an enabling environment for agricultural insurance. Some of the key commitments made include policy, regulation, and incentives to enhance insurance adoption among smallholder farmers. Governments can achieve the goal of insurance development by subsidizing the premium, entering risk-sharing schemes, and engaging in other cooperative activities with private companies, ensuring higher insurance rates in the agricultural field and increasing the liveliness of the rural economy. Also, they guide the social insurance policies and programs, as well as evaluate and revise them about the emerging issues and trends on the ground.

3.3.4 Agricultural Experts

Agricultural experts, including academics and practitioners specializing in risk management, provide valuable insights and technical expertise to support the design, implementation, and evaluation of agricultural insurance programs. They work on the research plans, create and tend models, and engage in training and capacity building to increase awareness of the risks and coverage solutions among insurance stakeholders. Agricultural experts assist in coming up with insurance products and risk mitigation strategies, as well as other products and practices, through the evaluation of risk assessment to enable smallholder farmers to effectively mitigate the risks they face with the complexity involved in decision-making when it comes to uncertainty.

3.4 Data collection

The data for this study were collected from April to July 2024. The primary aim was to gather comprehensive information from two distinct groups: 144 farmers and 40 agricultural insurance companies in Kenya. This bilateral strategy was designed to offer a broader perspective of the state of affairs of agricultural insurance, taking into consideration both the insurance offer side and the demand side corresponding to farmers.

3.4.1 Farmers

The target population for this study was comprised of farmers with different levels of exposure to agricultural insurance products, and the selected sample of 144 farmers was purposefully chosen

with the assistance of farm bureaus across the regions in Kenya. The sampling technique ensured that the researchers covered all types of farming, methods of farming, and the kinds of crops being grown across the region.

Farmers were contacted by reaching out to their local agricultural extension services as well as farmer cooperatives. Awareness of the study was created through bulletins, community meetings, and Agriculture Show events. The participants who agreed to be part of the study were given a questionnaire. Some questions posed in the questionnaire were closed-ended while others were open-ended, and some of them included awareness and use of agricultural insurance, perceived risks, and the financial implication of insurance on farming. This strategy aimed at increasing the response rate and the quality of data collected from the farmers by helping the field assistants become familiar with the questionnaires and the ways of completing them.

3.4.2 Agricultural Insurance Companies

The 40 agricultural insurance companies were screened based on the role they play in providing agricultural insurance products in Kenya. This was done to ensure that there is a combination of both private and public insurers to get a holistic view of the industry. These companies were first approached by formal letters in which the intention of the study was introduced and the companies were invited to be part of it.

The required data were gathered with the help of semi-structured interviews and company records of the insurance companies. The interviews were concentrated on aspects such as the companies' views about the prospects and threats of the agricultural insurance market, both offered insurance products, underwriting and claims, and general experience in the agricultural industry. Moreover, official documents of the companies offered precise information on the number of policies sold, claims ratio, and profit or loss performance figures connected to agricultural insurance products.

3.5 Variables

The identified research variables helped describe the factors influencing the utilisation and effectiveness of agricultural insurance in Kenya.

3.5.1 Dependent Variables

Insurance Uptake: This variable indicates how far the farmers have subscribed to the various schemes of agricultural insurance (Vyas et al., 2021). It also showed the degree to which the farmers

relied on and availed of the insurance services as well as the level of compliance with risk management tools amongst the farmers.

Coverage Effectiveness: This variable seeks to know how well insurance products address and reduce risks and offer financial security to farmers. This proved that insurance helps in providing compensation for the amount of lost revenues and extra support in undesirable circumstances, which measures the efficiency and relevance of insurance.

Farmer Resilience: This variable served to assess the farmers' resilience to recover from premiums associated with insurance coverage (Meuwissen et al., 2019). It highlighted the insurance constant from the farmers' viewpoint, explaining how insurance enables them to manage climate and other economic disasters in the long run.

3.5.2 Independent Variables:

Socio-economic Characteristics: These included factors such as age, gender, income level, and education of farmers. Awareness of these characteristics aided in the determination of demographic trends in insurance and outcomes, profit gaps influenced by SES, and their impact on farmers' decision-making.

Access to Information: This variable assesses the availability and quality of information regarding agricultural insurance. It analysed the extent to which farmers have insurance information within their reach about the insurance options available, the benefits, and the insurance procedures, which showed the effectiveness of information provision towards insurance exploitation.

Institutional Arrangements: This variable evaluated the role of government and private institutions in promoting and managing agricultural insurance. It focused on the key aspects of institutionalism, policies, and collaboration about expanding access to and the credibility of insurance solutions.

Technological Innovations: This variable examined the use of advanced technologies such as satellite imagery, mobile platforms, and data analytics in insurance products. It explored how technological innovations contribute to the development, distribution, and management of insurance schemes, improving their accessibility and effectiveness for farmers.

3.6 Data Analysis

The data analysis process involved both quantitative and qualitative methods to provide a comprehensive understanding of the collected data.

3.1.1 Quantitative Data Analysis

The quantitative data from the farmers' questionnaires and insurance company records were analysed using frequency analysis. IBM SPSS Statistics Version 22 was used for this purpose. The analysis included calculating frequencies for variables such as awareness of agricultural insurance, types of risks faced, insurance coverage, and technological innovations.

3.1.2 Qualitative Data Analysis

The qualitative data from open-ended questions in the farmers' questionnaires and interviews with insurance company representatives were analysed using thematic analysis. This method involved identifying, analysing, and reporting patterns (themes) within the data.

Coding: The first step in thematic analysis was coding the data. Each response was read thoroughly, and relevant information was highlighted and assigned a code. Codes were words or short phrases that captured the essence of the response.

Themes Development: After all the data were coded, analogous codes were combined into themes. Themes were broader patterns in the data, and they helped with making an understanding of the data being collected. For instance, some of the themes that arose from farmers' responses were perceived advantages of insurance, reasons for non-adoption of insurance, and perceived credibility of insurance companies. On the part of the insurance companies, themes like underwriting difficulties, claim handling problems, and alternative insurance products featured prominently.

Interpretation: The final stages were to assertively synthesise the themes to be fit for purpose and identify what the results meant. This entailed relating them to the research questions and objectives to appreciate the efficiency and gaps in agricultural insurance in Kenya.

3.1.3 Triangulation

To increase the reliability and credibility of the research, data triangulation was used. In essence, triangulation must involve cross-checking the data, the method used to collect it, or even the researcher conducting the research. Findings from this analysis included similarities and differences between farmers and insurance firms. This approach was useful in establishing a broader and well-grounded estimation of the agricultural insurance scenario in Kenya.

3.7 Ethical Considerations

The ethical considerations were highly relevant while performing data collection and also data analysis. All participants signed a consent form, which made them understand the reason for undertaking the study, the methods that would be used, and the possible risks involved. Security was observed by keeping data anonymous and all information closely kept (Khan, 2015). The participants were informed that they were free to participate in the study and that they did not necessarily have to be part of the research if they so wished, as well as that they could quit the research at any time of their own accord.

3.8 Limitations

Although this study has benefits, it is crucial to note its shortcomings. One major limitation is the use of self-reported data collected from farmers, meaning that responses given might be influenced by the participant's perception or else recall bias. Furthermore, the purposive sampling technique is very useful in identifying participants of interest but may put a restriction on the transferability of the results to the other categories of farmers in Kenya. However, this study is not perfect as it follows the method mentioned below. Despite these limitations, this study has collected and analysed data comprehensively to present generalisable conclusions that can be of important value in comprehending the prevalent state of affairs in the field of agricultural insurance in Kenya.

This research employs a mixed research method and provides a detailed account of the existing state, issues, and trends in the agricultural insurance sector in the Kenyan context (Rutledge & Hogg, 2020). These research results are intended to enhance policy-making to include accessible insurance products for the farmers in Kenya.

4.0 Chapter 4: Analysis and Results

4.1 Qualitative and Quantitative Analysis

This section attempts to discuss and explain the results of the survey as well as the results of semi-structured interviews conducted. The results are analysed in a qualitative manner leading to a quantitative analysis of the respondents' perceptions and observations. Thus, it is possible to identify, for instance, the general trends or patterns or relations between them in general, noting tendencies in participants' attitudes. The Semi-structured interviews on the other hand are analysed qualitatively since they are supposed to reveal the abstract and unique encounter of the respondent in a certain social activity. Qualitative analysis is based on subjectivity and has particular applicability — it helps to comprehend the nuances of considering subjectivity, where additional light is shed as compared to figures and stock data. The target respondents for the interview were chosen depending on their connection with the firms within the insurance industry in Kenya, while the agriculture industry, in general, was targeted to increase the level of generalizability of the findings. This way, the issues under research are captured well in their entirety as organized by the two methods of research.

Quantitative analysis methods are fundamental in identifying trends and relationships within raw data, enabling researchers to derive meaningful conclusions and make informed decisions. Nemoto and Beglar, (2014) stated that these Likert-scale questionnaires methods facilitate quantitative analysis of numbers, which can provide certain patterns missed in qualitative analysis. In this study, therefore, quantitative analysis helps to capture the various opinions of the farmers and insurance service providers on risk assessment and hedging in agricultural insurance. Statistical techniques enable the research to identify specific trends and patterns affecting the decision-makers among these stakeholders. They are especially useful in tackling agricultural business because they incorporate risks in farming, as earlier illustrated. The structured approach of qualitative research affords the analysis of data in a manner that enhances its usability for change, which is useful given the developments made in the agricultural insurance schemes in Kenya.

The quantitative data for this study have given a qualitative perception from the farmers' and insurance providers' sectors about the significant aspects of risk assessment and coverage of agricultural insurance. To obtain these views, the survey used a Likert scale questionnaire that provided the respondents with predetermined statements and their level of endorsement concerning the role of agricultural insurance in the management of risk in Kenyan farming. The research team had to pre-code the categories before data collection this made the data analysis process easy

because the data was coded in advance thus it was easy to sort them when analysing. This approach also proved to be very efficient in terms of time constraints as well as reducing the likelihood of mistakes in data entering and coding. The fact that the survey was guided and the use of a Likert scale aided the researchers in comparing the responses of different stakeholders in the process of designing agricultural insurance. Such understanding is vital in the formulation of appropriate policies and insurance that will improve the satisfaction of the farmers as well as insurance companies.

Quantitative data from the survey was analysed using frequencies, tables, and charts to identify patterns, relationships, and differences within the variables. This method helped the research group provide a detailed analysis of the collected data, revealing relationships that may have been otherwise hidden. Frequencies gave a general overview of how often certain responses appeared, while tables made it easier to identify key highlights. SPSS software was used for data management, statistical analysis, and graphical representation, improving the accuracy and presentation of the results, making them more accessible and understandable to a broader audience.

4.1.1 Frequency Tables and Charts

Frequency tables were chosen to represent the various responses obtained from the Likert scale questions (Nemoto & Beglar, 2014). This approach helped in presenting the data in an arranged manner where patterns and trends of the answers given by the respondents could easily be noted. Spread emphasis was placed on key elements, such as the current risk assessment, the extent of current insurance products, as well as technology's impact on agricultural insurance. By analysing the responses to these key areas by creating frequency tables, it would be possible to gain much-needed insights into the views of the respondents. This method of data analysis was not only helpful in the interpretation of the collected data but was also valuable for further analysis because it gave a clear structure to the further stages of the research and allowed the researchers to make proper recommendations based on the outcomes of the survey.

Table 1 The importance of risk management in agricultural insurance as perceived by farmers

Response	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Strongly Agree	50	34.7	34.7	34.7
Agree	70	48.6	48.6	83.3
Neutral	15	10.4	10.4	93.7
Disagree	9	6.3	6.3	100.0
Total	144	100.0	100.0	-

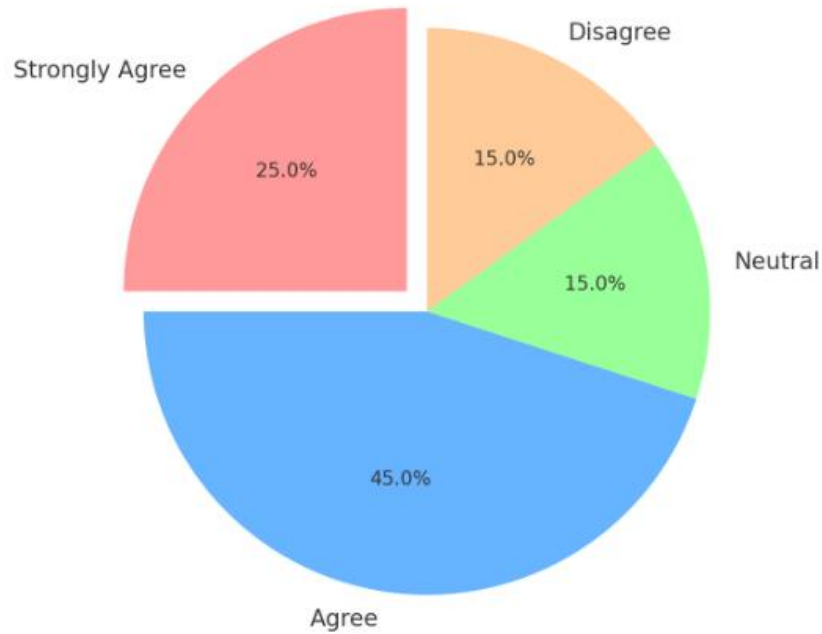
This frequency table illustrates that a significant majority of the farmers, 48.6%, agreed that risk management is crucial in agricultural insurance, while 34.7% strongly agreed. Only a small fraction, 6.3%, disagreed, indicating a consensus on the importance of risk management in mitigating agricultural risks.

Table 2 Insurance companies' views on the sufficiency of current agricultural insurance coverage

Response	Frequency	Per cent	Valid Per cent	Cumulative Percent
Strongly Agree	10	25.0	25.0	25.0
Agree	18	45.0	45.0	70.0
Neutral	6	15.0	15.0	85.0
Disagree	6	15.0	15.0	100.0
Total	40	100.0	100.0	-

This table highlights that 45% of the insurance companies agreed that the current agricultural insurance coverage is sufficient, while 25% strongly agreed. However, 15% disagreed, suggesting that there is room for improvement in the scope of coverage offered.

Figure 1 Insurance companies' views on the sufficiency of current agricultural insurance coverage.



The pie chart indicates that the majority of respondents believe the coverage is adequate, with a notable portion, 30%, expressing neutrality or disagreement, indicating potential gaps in coverage that need to be addressed.

Table 3 Farmers' awareness of agricultural insurance products

Awareness Level	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	75	52.1	52.1	52.1
Agree	50	34.7	34.7	86.8
Neutral	19	13.2	13.2	100.0
Total	144	100.0	100.0	-

This table shows that a majority of the farmers, 52.1%, reported high awareness of available agricultural insurance products, while 34.7% had moderate awareness. A small percentage, 13.2%, had low awareness, indicating a need for increased outreach and education.

Table 4 Farmers' perception of the adequacy of insurance coverage

Adequacy Level	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	40	27.8	27.8	27.8
Agree	65	45.1	45.1	72.9
Neutral	39	27.1	27.1	100.0
Total	144	100.0	100.0	-

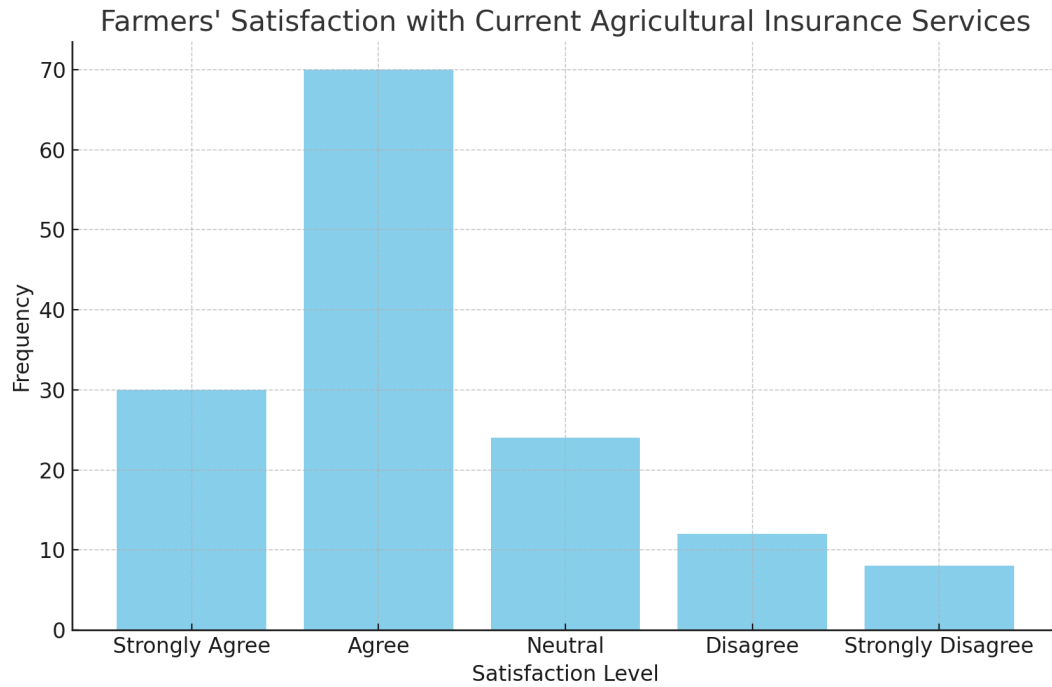
According to this table, 45.1% of the farmers perceive their insurance coverage as moderately adequate, while 27.8% consider it highly adequate. Another 27.1% find the coverage inadequate, highlighting areas for improvement.

Table 5 Farmers' satisfaction with current agricultural insurance services

Satisfaction Level	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	30	20.8	20.8	20.8
Agree	70	48.6	48.6	69.4
Neutral	24	16.7	16.7	86.1
Disagree	12	8.3	8.3	94.4
Strongly disagree	8	5.6	5.6	100.0
Total	144	100.0	100.0	-

The majority of farmers, 48.6%, expressed satisfaction with their insurance services, while 20.8% were very satisfied. However, 8.3% were dissatisfied, and 5.6% were very dissatisfied, indicating some dissatisfaction among a minority of respondents.

Figure 2 Farmers' satisfaction with current agricultural insurance services.



The bar chart shows that while most farmers are satisfied, a noticeable minority is not, suggesting potential areas for service improvement.

Table 6 Perceived impact of agricultural insurance on farming activities

Impact Level	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	42	29.2	29.2	29.2
Agree	65	45.1	45.1	74.3
Neutral	25	17.4	17.4	91.7
Disagree	8	5.6	5.6	97.3
Strongly disagree	4	2.7	2.7	100.0
Total	144	100.0	100.0	-

This table reveals that 45.1% of farmers perceive the impact of insurance on their farming activities as positive, with 29.2% viewing it as very positive. However, a small percentage, 8.3%, view the impact as negative or very negative.

Table 7 Adoption rate of technological innovations in agricultural insurance.

Adoption Level	Frequency	Per cent	Valid Percent	Cumulative Percent
Strongly Agree	60	41.7	41.7	41.7
Agree	50	34.7	34.7	76.4
Neutral	34	23.6	23.6	100.0
Total	144	100.0	100.0	-

The majority of farmers, 41.7%, reported a high adoption of technological innovations in agricultural insurance, with 34.7% showing moderate adoption. However, 23.6% had a low perception of technological innovations.

4.2 Quantitative Conclusion

The quantitative analysis of the survey data provides a comprehensive understanding of the perspectives of farmers and insurance providers on various aspects of agricultural insurance in Kenya. According to the research findings, it is evident that farmers do have adequate awareness of risk management of agricultural insurance and its relevance. However, insurance providers indicated that the current tender offer is adequate, but there is still a reasonable portion that perceived that insurance coverage has drawbacks. The overall perception results indicate that farmers are fairly content with the current insurance services but a few raised dissatisfaction concerns while indicating the room for improvement. The results also show a good level of technological understanding and integration among farmers, pointing to a favourable trend in the modernization of agricultural insurance. These findings underscore the fact that there is a need for further enhancement of coverage and service delivery to respond to the diverse needs of the various stakeholder groups in the agriculture value chain.

4.3 Qualitative Analysis

4.3.1 Approach to Qualitative Analysis

Ezzy (2013) stated that qualitative analysis involves the detailed interpretation of textual data to uncover underlying meanings and patterns. The interviews that were conducted aimed at the application of semi-structured questions among the representatives of the insurance farmers and the government within Kenya's agriculture sector. These interviews were conducted and documented professionally with the intent of ensuring that a detailed analysis of the participant's responses was possible.

The analysis of the obtained data focused on the method of thematic analysis, which was described by Gibbs (2014) and implies the identification of themes that occur frequently within the research data. The themes were assessed through the inductive approach through which concepts are generated upon analysing the data collected and testing a hypothesis, while the deductive approach involved coming up with themes and comparing them with the research questions and objectives formulated. This dual approach simplifies the idea that is under investigation by catching both the big picture and the details needed to explain why and how the big picture is so.

Several key issues emerged from the interviews that are characteristic of agricultural insurance in Kenya today, including the suitability of risk assessment tools, adequacy of coverage, the influence of technology, as well as the problems of the regulatory environment. The obtained themes were further explored to establish their application to the advancement and implementation of agricultural insurance solutions.

4.4 Summary of Findings

The analysis identified key themes in the agricultural insurance sector in Kenya, including the effectiveness of risk assessment methods, the adequacy of insurance coverage, technological innovations, and challenges in the regulatory framework. These themes are relevant to the sector in as much as they highlight issues that need to be overhauled in terms of coverage and the way that risk assessment is conducted. Concerning the insurance deliverables, the technological application was identified as playing a role in insurance delivery while on the other hand, the regulatory factors were found to hinder the insurance sector. This study focuses on problems that need to be addressed to increase the effectiveness of agricultural insurance schemes in Kenya.

4.5 Thematic Analysis

The thematic analysis revealed several key themes that encapsulate the primary concerns and insights of the stakeholders involved in the agricultural insurance sector. These themes include the effectiveness of risk assessment methods, the adequacy of insurance coverage, the role of technological innovations, the challenges of policy and regulatory frameworks, and the impact of agricultural insurance on smallholder farmers' livelihoods.

4.5.1 Effectiveness of Risk Assessment Methods

One of the most prominent themes that emerged from the interviews was the varying perceptions of the effectiveness of current risk assessment methods used in agricultural insurance. Many insurance company representatives expressed concerns over the reliability and accuracy of these methods, particularly in the context of climate change and market volatility.

Another respondent from a leading insurance firm noted, "Our current risk assessment models are largely based on historical data, which may not be sufficient to predict future risks accurately. With the increasing unpredictability of weather patterns, we need more advanced tools that can incorporate real-time data and predictive analytics."

This sentiment was echoed by several other interviewees, who highlighted the limitations of traditional risk assessment methods. They emphasized the need for more dynamic models that can account for the rapidly changing environmental and economic conditions that affect agricultural productivity.

Conversely, some insurance providers believe that while current methods are not perfect, they are still effective when combined with robust risk management strategies. As one respondent put it, "The challenge isn't just in the assessment itself, but in how we use the information. If we can integrate risk assessment with proactive risk management, we can significantly mitigate potential losses."

Farmers, on the other hand, had mixed views on the effectiveness of risk assessment. While some farmers felt that their insurance providers were able to adequately assess risks and offer appropriate coverage, others were skeptical, citing instances where they felt their risks were underestimated or misinterpreted. This divergence in views points to a gap between the technical assessments made by insurers and the on-the-ground realities faced by farmers.

4.5.2 Adequacy of Insurance Coverage

Another critical theme identified in the interviews was the perceived adequacy of insurance coverage provided to farmers. This theme was particularly significant given the complex and varied nature of

risks faced by farmers, ranging from climate-related events to pests, diseases, and market fluctuations.

Many farmers expressed concerns that the current insurance products available to them did not fully cover the range of risks they face. One farmer from the Rift Valley region stated, "The insurance covers us for drought and floods, but what about the pests and diseases that destroy our crops? We need insurance that can protect us from all these threats, not just some of them."

This concern was shared by several other farmers, who noted that while agricultural insurance had helped them mitigate some risks, the coverage was often too narrow to provide comprehensive protection. For example, some farmers reported that their insurance did not cover post-harvest losses or market price fluctuations, both of which can have a significant impact on their livelihoods.

Insurance providers acknowledged these concerns, with several respondents admitting that their current products might not fully address the needs of all farmers. However, they also pointed out the challenges of offering broader coverage, such as the increased costs and complexities associated with underwriting more comprehensive policies. One insurance executive explained, "We understand the farmers' concerns, but expanding coverage to include every possible risk would make the premiums unaffordable for many of them. We have to strike a balance between providing adequate coverage and keeping the insurance accessible."

4.5.3 Role of Technological Innovations

Technological innovations were widely discussed as a potential game-changer in the agricultural insurance sector. The insurance companies and farmers knew the potential of technology in risk evaluation, the development of insurance products, and the enhancement of the insurance delivery process.

Some of the insurance companies said that they were already seeking or had started adopting technological advancements to improve their products. Such innovations incorporated satellite imagery functionalities for cropping conditions, weather sensors for data collection, and mobile platforms for insurance delivery.

One respondent from a technology-driven insurance firm described their approach: "We have sought to combine satellite data into our risk models to make assessments more accurate and timely for underwriting purposes and also for offering what we refer to as parametric insurance that pays out when certain pre-determined conditions are met."

The overall perception toward technological development was generally positive, especially from farmers who benefitted from the various developments. Another farmer stated, 'The change I've seen is that the mobile app makes it easier to check on my policy and submit claims... I also like how they use satellites to track the crop, and that makes me know my risks are accurately estimated.'

However, the interview also provided information on some of the issues that farmers faced when implementing technological solutions in agriculture insurance. Some of the concerns that were raised by the farmers included the question of how readily available these technologies are, especially in rural and arid regions where internet connection is a major issue. There were also concerns that data and information gathered through technological aid raised concerns with data credibility, with one farmer noting that 'Sometimes satellite data fails to depict what happens at field level: for instance, there could be pest attack.'

Such issues were recognized by insurance providers, but they were encouraging mobility ahead; technological breakthroughs might solve most of these problems. They also stressed one of the key sides of using these new tools with farmers in terms of training the farmer in a manner that he can adapt to these available new tools.

4.5.4 Difficulties of the Policy and Regulation Surrounding

The policy and regulatory environment also featured as another key area of interest in the qualitative analysis. The participants had an equal concern about the extent to which the existing regulations on agricultural insurance are effective in Kenya.

Several insurance providers noted recent government initiatives and policies that aimed at enhancing agricultural insurance, including subsidies and the policy on the national agricultural insurance scheme. In particular, one of the respondents commented that "subsidies have received a lot of support from the government in making insurance affordable to farmers since the cost burden has greatly impacted the smallholder farmers."

However, other participants pointed to opportunities and weaknesses in the legal framework that hamper the proper functioning of agricultural insurance. For instance, through the interviews, some of the participants noted that regulatory frameworks are sometimes rigid, thus posing a major challenge in proving the necessary platform that would allow insurers to incorporate new products in the market. America Health Insurance Plans (AHIP) quoted an insurance executive who put it this way: "The current regulations are for insulin-type insurance models, and they leave little room in many cases for the new more flexible insurance types that we are trying to create."

Concerning the regulatory environment, farmers' worries included the situation with the enforcement of insurance contracts as well as the claim process's clarity. Some farmers also complained of the problem with the payment after making their claims; in their own words, "I too had to make a claim and get approval, but it took me months to receive my payment; they make it overwhelmingly complex."

These challenges call for more adjustments in the current regulatory environment to suit the changing nature of the agricultural insurance market. Interviewees stressed how coordination between the state, insurance companies, and farmers is crucial given that the regulations should work and be adjustable.

4.5.5 Impact of Agricultural Insurance on Livelihoods

The last area of analysis was the potential for agricultural insurance to support the livelihoods of smallholder farmers. Some of the farmers also pointed out the inefficiency of insurance in enhancing their financial security. Generally, farmers noted that through insurance, they gained some measure of protection against specific risks.

Some farmers disclosed that losses covered by agricultural insurance have assisted them in managing losses from drought or floods and that they were able to reinvest in their farms and carry out more farming. One farmer said, "Without insurance payout, I would have lost everything. I am happy the insurance was able to support me to get back into business."

However, other farmers were not convinced of the long-term benefit of the agricultural insurance. Some of the clients complained that insurance did not even offer them a cover for their loss or that the amount they were given was inadequate to cover the damages. That is the point one farmer stated: "The insurance helped to some extent, but I had to borrow money to compensate for the rest of my losses."

These mixed experiences underscore the importance of ongoing innovation and enhancement of agricultural insurance products. Market players highlighted such concerns as the need to guarantee that the insurance products offered not only come at a low price but also adequately protect farmers.

4.5.6 Barriers to Insurance Adoption

Barriers to insurance adoption were also touched on during the interviews, especially in the case of smallholder farmers. The most common problem mentioned by the farmers was the fact that premium prices were rather high and hardly affordable. This was truer for farmers who were virtually scratching

along the edge of the poverty level and for whom the costs of insurance also formed a big chunk of their expenditures. Another farmer said, “The premiums are simply too costly for my pocket... am barely managing to feed my family, insurance is something I can hardly afford.”

Besides cost, several respondents commented that insurance products are difficult to understand and therefore act as a hindrance. Some of the farmers indicated that they were able to grasp the policies they were offered, and this made them reluctant to buy insurance. This was further compounded by a problem of inadequate dissemination of relevant information about the insurance products available. One farmer said, “These insurance policies have a lot of legal language and I can’t comprehend most of them. I need to cover my farm but who will explain it to me”.

Trust was another problem area that came into the spotlight as a factor that may hinder the adoption of the technology. Some of the concerns which were raised by the farmers include unfairness in the way the claims are handled and question marks on the companies that provide the insurance. This lack of trust made them very hesitant to buy an insurance policy despite the fact they saw its value. One farmer stated, “I have lost count of numbers of people who never received their claims as expected I do not wish to be among those who use their money only to laugh at them when they are in need.

Last, the interviews revealed the importance of awareness of insurance and its purpose to encourage people to take up insurance. Several farmers said that they did not know the existing insurance products in the market or did not have a clue about how the insurance products could be useful to them. This lack of awareness was a major constraint to take up as farmers would not purchase insurance even if it could be accessed since they would not perceive its usefulness. One respondent said, “frankly, I had no clue that the insurance was allowed until a friend of mine told me, the theory, I believe if more farmers became aware of it, most of us would follow suit.”

4.5.7 Recommendations for Improvement

Interviews were carried out by asking respondents questions on how they would like to see the agricultural insurance in Kenya changed. Several of the farmers and insurance agents interviewed indicated that the government should subsidize more premiums, thereby extending the insurance to all the smallholder farmers. There was also a perceived need for the development of more appropriate insurance products that focus on various types of risks that farmers may encounter.

An insurance executive suggested, “What is required is to market more refined products that provide coverage for a wide number of risks and the government has to ensure that such products are cheap.”

Other areas where farmers desired improvements included the appearance of the claims process, where several of the respondents stated that insurance companies should clearly explain how the claims they submit are evaluated and why some of the claims could be rejected. Reaching out and enhancing the confidence that the insurers demonstrate to the farmers was deemed to be a key goal towards increased uptake of insurance. An agricultural expert opined, “A lot of emphasis has to be placed in campaigns to educate farmers on the importance of insurance and the need to safeguard their source of income.

Summing up the results of the interviews, it is possible to state that the respondents expressed the necessity of an improved and more effective agricultural insurance system in Kenya. This paper aims at availing solutions that include the removal of barriers to adoption, enhancement of the current risk assessment techniques, increase coverage and embrace technology, the insurance industry will be in a better position to provide support to the farmers and help uphold the sustainability of the Kenyan agricultural sector.

4.6 Summary of Qualitative Findings

Based on the interviews carried out with key stakeholders in the agricultural insurance sector in Kenya, several themes that capture the current dynamics in the market were established. Areas of concern highlighted included the applicability of risk assessment techniques, the adequacy of insurance to mitigate risk in a business, the role of new technology, the impact of the regulatory environment, and the Insurance Impact on Livelihoods.

The study establishes the fact that there is a clear indication that agriculture and its insurance can assume a rather important role in managing the unpredictable facets among the smallholder farmers, though, there are many aspects that need to be enhanced. They have pointed out the areas requiring more attention for improvement including better risk assessment, insurance, technology integration as well as improvement in regulatory requirements.

Overall, the effectiveness of agricultural insurance in Kenya will be a result of the timely determination of the challenges mentioned and the subsequent cooperation to find solutions for the challenges as well as the readiness to adapt to the needs of the farmers. Although this is qualitative, the findings assembled here can confer significant support for future theoretical and empirical work in this important domain.

5.0 Chapter 5: Discussion

The study has explored the innovations in agricultural insurance in Kenya, with a focus on risk assessment and coverage. The preceding chapters outlined the current state of agricultural insurance, the methodologies used in risk assessment, and the impact of technological innovations. This chapter synthesizes the findings, discussing their implications, the challenges that remain, and potential avenues for future research. The goal is to provide a holistic understanding of how these innovations can be leveraged to improve the resilience of smallholder farmers in Kenya.

5.1 Effectiveness of Risk Assessment Methods

Risk assessment is a critical component of agricultural insurance, determining the premiums and coverage that farmers receive. In Kenya, conventional approaches to risk analysis, which mainly rely on parameters including experience, have been considered inefficient when it comes to identifying future risks, especially in the current depleting environment due to climate change. The study highlights that while these methods provide a baseline, they fall short in accounting for the increasing unpredictability of weather patterns and the emerging threats from pests and diseases.

Technological innovations, such as satellite imagery and advanced weather forecasting models, have been identified as potential game-changers in improving the accuracy of risk assessment. These technologies enable data capture and analysis on a real-time basis; this can change insurers' chance assessment basis, serving better and more accurate information. But the streak on the implementation of these technologies has its pull. The challenges that are still apparent include the accuracy of data, the relatively high costs of implementation, and the necessity to recourse to a particular set of expert knowledge to make the best use of such data.

Despite these challenges, the expansion in the use of technology in risk assessment is a promising strategy for the development of agricultural insurance in Kenya in the future. Real-time and predictive analytics could help insurers bring products that are a better match to actual farmer risks. This could in turn make for a more accurate determination of premium charges and increase the level of confidence between farmers and underwriters.

5.2 Adequacy of Insurance Coverage

One of the central findings of the study is that current agricultural insurance products in Kenya do not fully cover the range of risks faced by farmers. Insurances related to climate risks such as drought and flood are already available in the market, but insurance for other risks like pest attacks, diseases,

and market price risks is still poorly developed. Farmers have complained of inadequate insurance coverage, arguing that insurance policies currently available do not offer enough coverage, especially in the event of post-harvest losses and fluctuating prices. This lack of coverage exposes the farmers to risk as much as they may insure themselves. The current study recommends that it is necessary to broaden the parameters of coverage that aim at these additional risks to make agricultural insurance a better form of risk management.

However, increasing coverage poses its risks and difficulties. Insurance companies have to ensure that they offer all insurance products at an affordable price while at the same time ensuring they offer all the insurance policies. Extending the coverage to other risks is also going to raise the insurance cost, and hence any attempt at passing that cost on to smallholder farmers is counterproductive. Hence there is a need for new products like premium subsidies or what are referred to as index-based insurance products that can lead to payments based on these indexes and not actual losses as would be expected.

5.3 Impact of Technological Innovations

Technology has the potential to revolutionize agricultural insurance, making it more accessible, efficient, and responsive to the needs of farmers. The study outlines a few technologies that are already being implemented in Kenya in areas of insurance registration and claims processing via mobile technologies and crop monitoring and health checks via satellite imaging. These innovations have several implications, which are highlighted below, they can help to decrease the administrative costs that are characteristic of the traditional insurance models and allow farmers to obtain the insurance products and file claims simpler. Also, proper utilization of technologies such as satellite imagery will mean more correct and timely evaluation of risks, resulting in faster rates of payout and satisfaction among farmers.

However, some challenges come with the use of technology in the provision of agricultural insurance. Some farmers are located in rural areas where internet connection may be scarce, and some questions can be raised concerning the validity of data that is sourced through technological tools. However, the uptake of new technologies involves learning processes, and farmers may need user training to optimally exploit the technologies. Despite these challenges, the study suggests that continued investment in technology is crucial for the future of agricultural insurance in Kenya. Overcoming the barriers to adoption and enhancing the availability of such technologies, insurers stand to benefit smallholder farmers and enhance the food security sector in the process.

5.4 Challenges in the Policy and Regulatory Framework

The policy and regulatory environment play a critical role in shaping the effectiveness of agricultural insurance. The study identifies several challenges within the current regulatory framework in Kenya that hinder the development and implementation of innovative insurance products. One of the challenges highlighted is the inflexible legal framework that exists, which was developed to support the standard insurance concept rather than the dynamic models of insurance, such as, for instance, index-based insurance. The inability to be flexible and respond to trends and demands can impose a problem of few choices in insurance products; thus, it becomes a challenge for insurers to bring better-suited products to the smallholder farmers.

Another is the problem that arises about the implementation of clauses and terms of insurance policies and the clarity of the procedures of the insurance claims processes. People involved in farming have complained of challenges receiving their payments, and this has been marked by delays as well as cumbersome procedures. These challenges thereby erode confidence in the insurance system and may dent the enthusiasm of the farmers to embrace the insurance products. To overcome these concerns, the study suggests the need to enhance the regulatory framework in a way that fosters innovation while providing reasonable levels of protection to farmers.

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5.5 Impact on Smallholder Farmers

Agricultural insurance has been considered an efficient risk management tool that can help the world's smallholder farmers by providing them with a safeguard against the various risks in farming. These risks include the sustained improper, unstable conditions, pests, and diseases under which crop yields are affected, and hence the growers' income. Agricultural insurance should enable farmers to recover from their debts shortly after an event of mishap has happened to enable them to inject capital back into their fields. However, several challenges put a constraint on the profitability of agricultural insurance, which is central to amplifying the significance of the effort put into removing the barriers to strengthen the existence of smallholder farmers.

One of the key problems is the sufficiency of the level of financial security in insurance. In most cases, clients are provided with a paltry amount as per the insurance companies, thus denying the farmers their fair worth by under compensating them for their losses. For example, when a farmer has a crop failure as a result of a particular climatic condition like drought or floods, he or she will be compensated, and the amount of compensation is always likely to cover only a tiny proportion of the cost of production and replacement of the farm. This weak coverage makes them have a vulnerable financial position whereby they cannot feed, restart their lives, and get their losses compensated, contrary to what they expected when they subscribed to insurance to cover such areas.

Another important issue that arises is the availability of agricultural insurance products for smallholder farmers. High premiums remain a limiting factor because most smallholders are classified as low-income earners and cannot afford to pay a lot of money for insurance. Furthermore, the terms used in policies are somehow complicated, and the people who make the policy do not understand how insurance operates. Smallholder farmers are not fully knowledgeable about how insurance could help them, and the complications of insurance policies deter them from accessing any policy.

To ensure that the agricultural insurance produced the right intervention targeted at the intended beneficiaries, smallholder farmers, the following measures are proposed. One of the measures is the government raising subsidies for insurance premiums to make insurance cheaper for smallholders. Moreover, there is a lack of insurance products that would be designed for certain profiles and categories of farmers and their risks depending on certain crops or certain regions. Furthermore, it is necessary to step up education and outreach so that the population, including farmers in the first place, knows how insurance can help them, and they would be enticed to use it as a tool to minimise risks.

5.6 Barriers to Adoption and Recommendations

The study identifies several key barriers to the adoption of agricultural insurance in Kenya, particularly among smallholder farmers who are most vulnerable to farming risks. Such concerns include cost, which remains a prohibitive factor seeing that farmers lack sufficient cash to pay for premiums due to their fluctuating and generally low incomes. Furthermore, the issue of insurance has a problem of complicated policy documents, which deters farmers from understanding the policy wording. Lack of trust in insurance providers is also a strong factor that hampers take-up, whether due to personal experience or knowledge from people of slow or refusal in claims payments. All these factors explain

why the adoption of agricultural insurance is a difficult feat, even though its importance cannot be doubted.

To overcome these challenges, the study recommends that the following measures be taken to enhance the uptake of agricultural insurance in Kenya. Farmers' access to insurance also needs to be increased, as subsidies or other incentives can help reduce the cost of insurance for the farmers. Adapting also requires the simplification of insurance products to be more easily understandable by those with little education. Moreover, improving the relationship between the insurer and the farmer whom they are insuring might remove barriers because the more often and clearly insurers explain to farmers the compensation process and their rights, the better the trust generated is. By addressing these factors with a combined input of the public and private domain, the hurdles of adoption can be greatly eased.

One of the most promising strategies for increasing the adoption of agricultural insurance is the use of index-based insurance. Such kind of insurance offers protection against some factors that are more or less tangible, including rainfall intensity. Index-based insurance is cheaper because there is no need for underwriters to undertake costly and time-consuming assessments of each claim. It also has more transparency because certain criteria or conditions must be met for the payout to be made. This notion makes the insurance easily understandable and appealing to farmers, hence improving the uptake of the insurance despite jitters from conventional insurance products.

Additionally, the study suggests that insurers should invest in education and outreach programs to help farmers better understand the value of insurance and how it can protect their livelihoods. Forum and relations with local agricultural extension services. These include ensuring that facts regarding the insurance process are made clear and easy to understand in a bid to counteract all the myths around the insurance, which may incline farmers not to purchase insurance. Thus, by providing more and more targeted information to farmers, they can learn about the positive effects of insurance, increasing the coverage of such products, and, as a result, making farmers' financial position less vulnerable to various risks in agriculture.

5.7 Limitations of the Study

While this study provides valuable insights into the innovations and challenges in agricultural insurance in Kenya, it is not without limitations. One significant limitation is the reliance on self-reported data from farmers and insurance providers. Self-collected data may contain bias including recall bias whereby respondents may not remember past events accurately or may provide inaccurate

information knowingly or unknowingly. This can have an impact on the findings made by the study and points towards issues including risk appraisal and insurance sufficiency.

Another limitation is the scope of the study that was carried out in specific geographical regions only. To ensure the study had a cross-sectional sample of Kenyan farmers, most of the participants were selected from the districts with fairly good access to agricultural insurance products. This may put a bias to the results since it might have affected the ability of farmers in remote or hard-to-reach regions to access insurance services. As a result, the results of the study may be less representative of those farmers who operate in these more remote areas.

The study also faced limitations related to the adoption and use of technology in agricultural insurance. Although the study revealed that technological advancement was vital in enhancing risk assessment and availing insurance cover, the study did not delve much into the issues of the digital divide in Kenya. Some of the farmers are in areas that have restricted internet access and may not be in a position to take advantage of the hi-tech facilities thus demarcating the farming communities.

The use of qualitative data from official interviews with officials, although detailed, can be considered a limitation in terms of population coverage. The ideas and perceptions of the selected persons, even as informative as they may be, might not give the perception and experience of the sample agricultural segment of the whole country of Kenya. There is also scope for expanding the samples and for taking in more of the data to avoid such limitations and to provide a better insight into the matters at issue.

5.8 Future Research Directions

This study implies that African innovations for agricultural insurance hold the key to transforming the lives of smallholder farmers in Kenya. Through statistical risk modelling techniques, insurance coverage has to be extended, and through the use of technology, agricultural insurance has to conform to the type of risk faced by farmers. However, realising this potential involves some challenges, as highlighted in this study: deficiencies in coverage, regulatory constraints, and issues with access and trust.

The study also shows that although innovations in technology, including satellite imagery, mobile platforms, and index-based insurance, present a shift toward better improvement, several challenges need to be met before success can be achieved. Among these are the push to scale up investment in infrastructure like those in rural areas and the capacity and support that will help farmers adopt these technologies. Moreover, there is a necessity for the legal environment to be more flexible and

to accommodate these innovations to adopt effective and innovative insurance solutions that could be valuable for the farmers.

A key takeaway from the study is the importance of collaboration among stakeholders, including government agencies, insurance providers, farmers, and technology developers. They can help create additional insurance products and services that can better address farmer's needs, using policies that encourage insurers to offer affordable and accessible insurance products to farmers including the smallholder ones. Another advantage of this approach is that it fosters trust between farmers and insurers which has been an issue of concern when it comes to the uptake of agricultural insurance.

Future research should aim at several important directions to develop the future advancement of agricultural insurance in Kenya. First, the insurance innovations require evaluation through longitudinal researches that aim at studying the insurance market's change after implementing innovations. They may also examine the complex relationships between climate change, farming practices, and insurance solutions to improve the models of risk estimation and policies and programs offered. Future research should devote a narrow focus to investigating the socio-cultural factors that affect insurance adoption. Insights into cultural perceptions, social relationships, and communities of farmers on insurance may help design culture-sensitive and community-appropriate insurance products. It might be especially important in regions where culture and family as one of the social structures significantly contribute to risk management.

There is an opportunity to widen the list of investigated insurance services which may act as complementary, for example, health or life insurance of farmers. There is potential to establish combinations of insurance products that will create a package that caters for farmers and the family resulting in higher use of insurance. Future research should focus on the role of public-private partnerships in driving innovation in agricultural insurance. Such partnerships could provide the necessary resources and expertise to develop and scale innovative insurance products while ensuring that they are aligned with national development goals and accessible to all farmers. Research in this area could also explore the potential for international collaboration, leveraging global expertise and funding to support the development of agricultural insurance in Kenya.

5.9 Conclusion

In conclusion, while this study has provided valuable insights into the current state and future potential of agricultural insurance in Kenya, it also highlights the need for ongoing research and innovation. By

addressing the limitations identified in this study and extending further into alternative, relevant and potentially valuable research areas, stakeholders can establish a stronger format of agricultural insurance system for the smallholder farmers to fend off food insecurity and improve the related aspect of economic growth in Kenya.

6.0 Chapter 6: Conclusion

Therefore, this thesis offers an overview of agricultural insurance in Kenya, specifically on how it can help in managing risks for the smallholder farmers. It points to how insurance can tackle problems like climate variability, pests, diseases, and market volatility (Mugo et al., 2020). It demonstrated the need to tackle these risks and set the scene for how these risks can be mitigated by effective risk assessment, innovative insurance products, and technological change in relation to sustainable agriculture (Osumba et al., 2020). These insights emphasize that agricultural insurance plays a vital role in securing food and livelihood for farming communities that are vulnerable.

The analysis of literature also focused on the conceptual and empirical foundations with reference to agricultural insurance. This analysis brought out the insurance challenges that exist in insurance uptake and that both farmers as well as insurers go through in the Kenyan situation. Some factors, such as affordability, trust, and lack of product coverage, were also found to be major barriers (Ndung'u, 2010). At the same time, technological innovations such as index-based insurance and mobile platforms were identified as promising to improve accessibility and efficiency. The synthesis of this research formed a foundation for discovering how to overcome these challenges and improve alignment between insurance services and farmers' needs.

The method used in this study allowed for the evaluation of the positions of the farmers, insurers, and the policymakers effectively. With the use of mixed methods, the study aggregated the complexities of agricultural insurance in terms of socio-economic factors influencing adoption and technological and regulatory drivers shaping the sector (Kramer et al., 2022). This finding highlighted the need for treatment, such as tailored solutions, to address the far-apportioned phenomena in Kenya's agribusiness landscape, rendering key facts concerning the operational and systemic changes that would contribute to improving insurance efficiency.

The data analysis brought out the critical themes, including the efficiency of existing risk assessment tools, insurance gaps, and possibilities of using technology. Farmers complained of expensive policies and inadequately adequate coverage, while on the other hand insurers complained of regulatory and operational hurdles (Hess et al., 2016). But central to bridging those gaps were innovations such as satellite imaging and parametric insurance. Stakeholders and policy interventions

were identified as necessary for a more equitable and robust agricultural insurance framework based on collaborative efforts among stakeholders.

In conclusion, this thesis highlights the interrelationship of good risk management, insurance innovation, and supportive policy in building Kenya's agricultural insurance. Pursuing a framework that is more inclusive and resilient, stakeholders can conquer systemic challenges and unlock the capabilities of technology. These efforts will also not only help to protect the ability of smallholder farmers to feed themselves, but they will also support other sustainable development goals in addition to food security and financial or economic stability.

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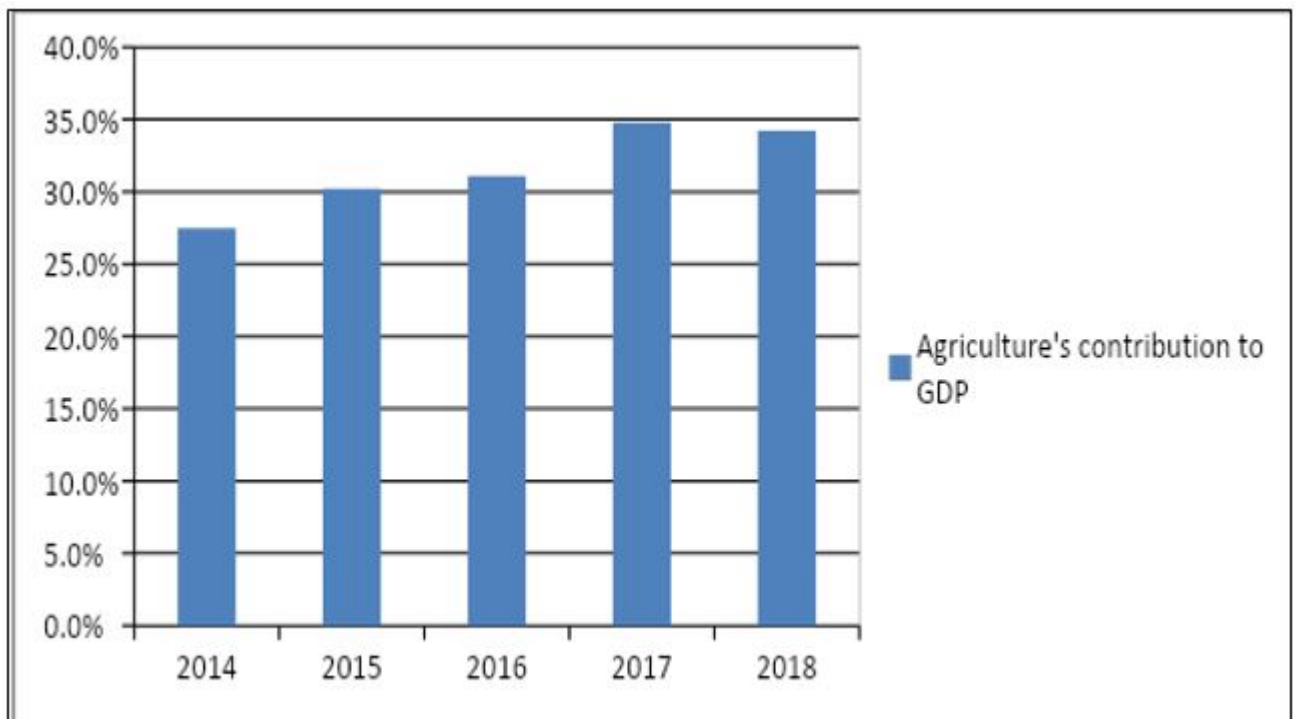
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Appendices

Appendix A: The Missing Market of Crop Insurance in Kenya - IEA Kenya

Figure 3 The Missing Market of Crop Insurance in Kenya - IEA Kenya



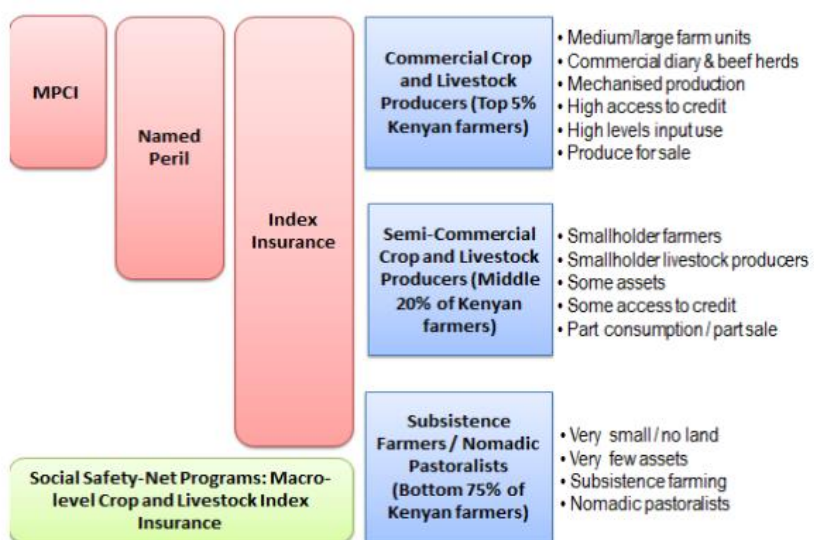
Appendix B: Innovative Approaches towards Agricultural Risk Management

Figure 4 Innovative Approaches towards Agricultural Risk Management



Appendix C: Kenya: Agriculture Insurance Solutions Appraisal

Figure 5 Kenya: Agriculture Insurance Solutions Appraisal



Source: MALF 2014

Appendix D: Risk Management Effects of Insurance Purchase and Organization in Agriculture

Figure 6 Risk Management Effects of Insurance Purchase and Organization in Agriculture

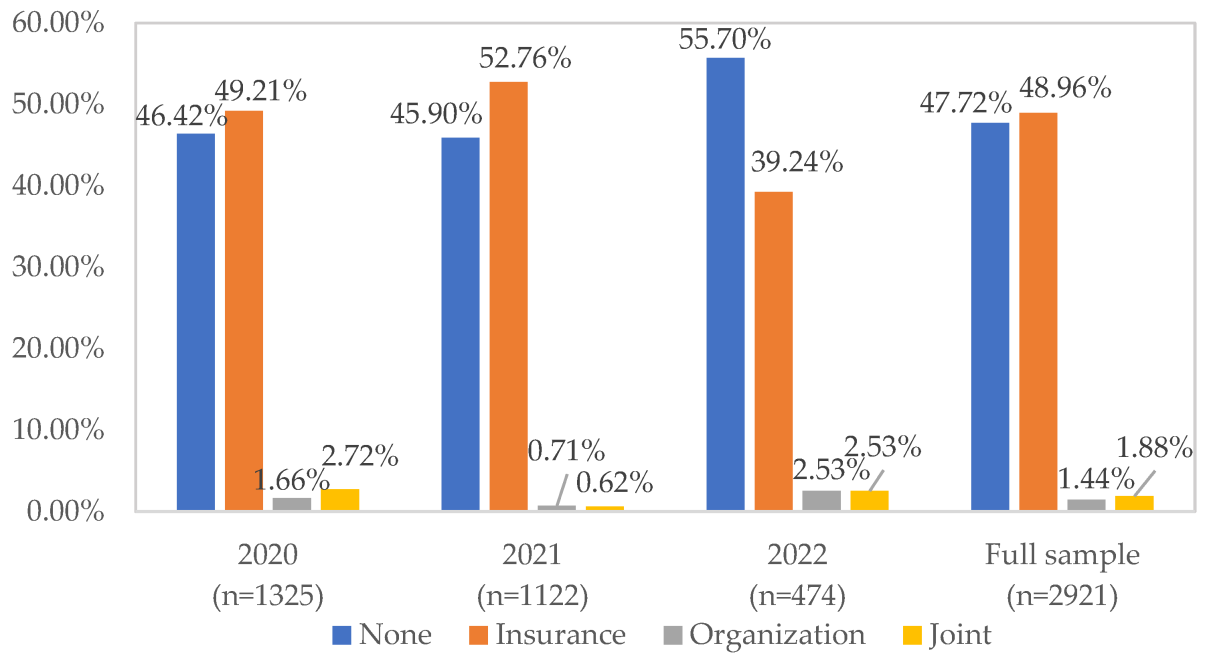


Figure 7 Agriculture risk management and role of insurance

Key Risks in Agriculture Sector

Production or Yield Risk

Market Risk

Asset Risk

Operational Risk

Institutional Risk

Financial Risk

Personal Risk

Variation in Weather Conditions and Natural disasters is a risk faced by the agriculture sector which affects the production and incomes of farmers

In India, the Agriculture sector is specifically exposed to high risks due to weather conditions due to:

- High dependence on rainfall
- Limited irrigation facilities
- Weak institutional structures
- Low use of technology