IMPACT OF RISK MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECTS IN KILIFI COUNTY, KENYA

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DECLARATION

Declaration

I affirm that this research thesis is my own original work. It has not been submitted to any other university or institution for any academic award or qualification.

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Approval

This project has been submitted for examination with our approval as the university supervisors.

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DEDICATION

To Moses Mwita, Paulina Robi, my late grandmother Elizabeth Maseke, Beatrice Monagi, and our children, Ian Chacha, Broun Mosenda, Blair Matiko, and Prisca Robi.

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ABSTRACT

This study explored the impact of risk management on the performance of smallholder tomato agribusiness projects in Kilifi County, Kenya. Smallholder tomato farming, a critical economic activity in Kilifi, faced numerous risks such as production challenges, market fluctuations, environmental stresses, and financial uncertainties. These risks significantly hindered farmers' ability to achieve stable incomes and improve their livelihoods. The study aimed to evaluate how effectively managing these risks can enhance the performance of smallholder tomato agribusiness projects, focusing on production, market, environmental, and financial risk management. The study was anchored in the Theory of Constraints (TOC) and the Management Theory of Project Management. TOC helps identify and address key bottlenecks such as inefficient production methods, fluctuating market prices, and environmental challenges. The Management Theory of Project Management guides structured planning, execution, and monitoring of risk management strategies. Together, these theories offered a holistic approach to understanding how risk management can improve the overall performance of tomato farming projects. A cross-sectional descriptive survey design was employed, targeting approximately 60,736 smallholder tomato farming households in Kilifi County. The study used multi-stage sampling procedures to select a sample size of 398 households, complemented by interviews with 12 key informants, including agricultural officers and cooperative leaders. Data collection involved structured questionnaires and interviews, and analysis included both qualitative and quantitative methods, such as thematic analysis and regression analysis. The study's findings are expected to benefit smallholder farmers by identifying practical strategies for mitigating risks and improving their income stability. Policymakers and financial institutions also gained insights into developing targeted interventions and financial products to support smallholder farming in Kilifi County. The research is likely to recommend increased access to climate-smart agricultural practices, better market information, and enhanced financial services.

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LIST OF ABBREVIATIONS AND ACRONYMS

FGD	Focus group discussion
GOK	Government of Kenya
GDP	Gross Domestic Product
FAO	Food and Agriculture Organization
NAFIS	National Farmers Information Service
EU	European Union
PRSP	Poverty Reduction Strategy Paper
MOTAD	Minimization of Total Absolute Deviation
CIDP	County Integrated Development Plan

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Globally, agriculture remains a critical sector, providing livelihoods and contributing significantly to food security and economic development. However, the sector is exposed to numerous risks such as climate variability, market fluctuations, pest infestations, and limited access to finance, all of which negatively affect the performance of agricultural projects. Risk management in agriculture has gained critical importance as a strategy to address these challenges and improve the overall success of projects. It involves the systematic process of identifying, evaluating, and mitigating potential risks, thereby strengthening resilience and enhancing the performance of agricultural initiatives (Mutenje et al., 2019). As global demand for food continues to rise, stakeholders have prioritized risk management in agribusiness projects to safeguard sustainability, particularly in vulnerable smallholder farming systems (FAO, 2021).

The global tomato agribusiness, like many perishable crop sectors, is particularly prone to risks related to weather, pests, and post-harvest losses. Smallholder farmers, who constitute a large percentage of global agricultural production, are disproportionately affected by these risks. This often limits their capacity to achieve optimal yields and economic returns. Recent initiatives aimed at introducing modern risk management strategies, such as crop insurance, improved technologies, and enhanced market access, have shown promise in reducing these vulnerabilities and improving the performance of smallholder tomato agribusiness projects (Raut et al., 2020). These strategies have been increasingly recognized for their potential to stabilize and enhance agricultural production.

In Africa, agriculture is the backbone of many economies, employing a large portion of the population and significantly contributing to gross domestic product (GDP). However, African smallholder farmers face unique challenges such as the effects of climate change, poor infrastructure, and limited access to financial services and risk mitigation tools. These challenges hinder their capacity to manage risks effectively. Risk management is vital for African agribusiness projects to ensure sustainability and resilience against these challenges (Blein et al., 2020). The adoption of risk management frameworks in African agricultural projects has been identified as a key factor in enhancing project performance, particularly in high-risk crops such as tomatoes, which are sensitive to environmental conditions and market volatility (Lipper et al., 2020).

Despite the growing recognition of the importance of risk management, the implementation of comprehensive strategies across Africa remains limited. Smallholder agribusinesses in many African countries, including Kenya, are often constrained by inadequate access to finance, limited market access, and ineffective risk mitigation strategies. As a result, these projects tend to exhibit inconsistent performance (Mohan et al., 2021). Risk management offers a way to reduce uncertainties in agriculture, allowing smallholder farmers to better plan and invest in their operations, ultimately leading to improved productivity and project outcomes.

In East Africa, agriculture is a key economic driver, with smallholder farmers contributing significantly to food production. However, the region's agricultural projects are frequently exposed to various risks, including droughts, pest infestations, and fluctuating market prices, which significantly affect their performance. The tomato agribusiness, in particular, is vulnerable due to the crop's perishable nature and the need for consistent management of the supply chain. In response to these challenges, risk management strategies such as the use of drought-resistant seeds, irrigation technologies, and cooperative marketing have been promoted to improve the

performance of smallholder agribusiness projects (Lalani et al., 2021). Despite these efforts, challenges persist in ensuring that smallholder farmers in East Africa can fully access and implement risk management tools and practices (Chacha & Katuma, 2020).

Furthermore, although some East African governments and international agencies have made strides in promoting risk management strategies, the uptake among smallholder farmers remains low. The lack of access to timely weather information, financial services, and agricultural insurance hinders the effectiveness of these strategies in improving project outcomes. In particular, tomato farmers face significant post-harvest losses due to poor risk management, which in turn limits the overall success of their agribusiness projects (Kilimo Trust, 2020). There is an increasing demand for risk management frameworks that are specifically designed to address the unique challenges faced in the region. Such frameworks are essential for enhancing both the performance and long- term sustainability of smallholder agribusinesses.

In Kenya, where agriculture is the backbone of the economy, smallholder farmers are crucial contributors, particularly in the production of horticultural crops like tomatoes. However, they face a variety of risks, such as unpredictable rainfall, pest outbreaks, and inadequate market access, which threaten the performance of their agribusiness projects. Risk management in Kenyan agriculture has thus become a focal point, with stakeholders emphasizing the need for improved irrigation systems, pest management, and access to agricultural financing (KIPPRA, 2021). Despite these efforts, many smallholder farmers in Kenya, particularly in rural areas, continue to struggle with effectively managing risks, leading to suboptimal project performance (Njeru et al., 2020).

Tomato farming in Kenya is particularly susceptible to environmental and market risks, as the crop requires precise management to avoid significant losses. Risk management strategies, including crop insurance and the promotion of climate-smart agricultural practices, have been introduced to address these challenges, with some success. However, the implementation of these strategies remains uneven across the country, and many smallholder farmers continue to experience losses due to unmanaged risks (Muriithi & Matz, 2022). Strengthening risk management practices in the tomato agribusiness sector is therefore crucial for improving project performance and ensuring the long-term sustainability of this important crop.

In the coastal region of Kenya, particularly in Kilifi County, smallholder tomato farming is an important economic activity. Farmers in this area encounter increased challenges, particularly as a result of unpredictable climate conditions, inadequate infrastructure, and insufficient access to essential agricultural resources. The region's vulnerability to erratic rainfall, prolonged droughts, and pest infestations has exacerbated the challenges faced by smallholder tomato farmers, resulting in inconsistent project performance (Kilifi County Government, 2021). Risk management practices such as the use of drip irrigation and integrated pest management are critical in mitigating these risks, but their adoption remains low among smallholder farmers in the region.

In Kilifi County, the performance of smallholder tomato agribusiness projects has been hampered by inadequate risk management practices. While efforts have been made to introduce risk management interventions, including irrigation schemes and pest control programs, many farmers still lack the necessary resources and knowledge to fully implement these strategies. As a result, the agribusiness projects in the region often experience significant losses, particularly during extreme weather events (Njiru et al., 2021). There is a pressing need to strengthen risk management

frameworks in Kilifi County to improve the performance of smallholder tomato agribusiness projects and ensure their resilience in the face of ongoing environmental and market challenges.

1.2 Statement of the Problem

In Kenya, agricultural project failure rates remain alarmingly high, with over 50% of initiated projects failing or underperforming. The cost of starting and running these projects is significant, yet many do not yield sustainable results (Kenya Agriculture Research Institute, 2012). A 2017 impact assessment in Kilifi County found that only 5 out of 13 community-funded projects were partially active, while the remaining 8 projects became defunct once external funding ended. The high failure rate, exceeding 60%, highlights a significant barrier to the long-term sustainability of agricultural projects, particularly for smallholder farmers. Even though the Ministry of Agriculture has introduced initiatives like the Smallholder Horticulture Marketing Program (2014), which emphasized the need to empower community-based organizations and enhance farmers' skills, the challenges of food insecurity and poverty remain prevalent. In Kilifi County, for instance, an alarming 53% of the population continues to live in severe poverty and face malnutrition. Local empirical evidence from Kilifi County reports and KALRO (2022–2024) quantifies the problem's significance: 60% of smallholder tomato projects failed due to unmanaged production risks (e.g., pest outbreaks reduced yields by 30%), while market volatility caused 45% of farmers to sell at a loss (KDAMIS, 2023).

The manifestations of these failures include delayed project completions, budget overruns, and, in some cases, incomplete projects with no clear accountability. This results in not only financial losses but also a reduction in food production, income instability for farmers, and deepened poverty levels in rural areas. The smallholder tomato agribusiness in Kilifi is particularly vulnerable due to market volatility, unpredictable weather patterns, and inadequate risk management strategies.

Smallholder farmers, who depend on these projects for income and food security, bear the brunt of these challenges, often lacking the resources or knowledge to effectively manage risks. Although significant research has been conducted on market access and the implementation of monitoring and evaluation (M&E) strategies in agriculture, much of this work has concentrated on the agricultural sector as a whole, rather than examining the specific role of risk management in the success of smallholder projects. Additionally, the effectiveness and challenges of current risk management strategies in improving project performance have not been sufficiently investigated. This study seeks to address this gap by exploring how various risk management practices influence the outcomes of smallholder tomato agribusinesses in Kilifi County, Kenya. The research will provide valuable insights into how risk mitigation can enhance the sustainability and overall success of these agricultural projects. Critical gaps persist in existing research: No studies examine the simultaneous bundling of production and market risks in Kilifi's tomato agribusiness, and There is an absence of mixed-methods frameworks for evaluating risks in tomato projects. This study bridges these gaps by investigating integrated risk bundling and deploying a mixed-methods approach to risk assessment.

1.3 Purpose of the Study

The aim of this research was to explore the impact of risk management practices on the performance of smallholder tomato agribusiness projects in Kilifi County, Kenya

1.4 Objectives of the Study

i. To analyze how production risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.
ii. To quantify how market risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.
iii. To evaluate how environmental risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.
iv. To assess how financial risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.

1.5 Research Questions

i. How does production risks management impact the performance of smallholder tomato agribusiness project in Kilifi County?
ii. How does market risks management impact the performance of smallholder tomato agribusiness project in Kilifi County?
iii. What is the impact of environmental risks management on the performance of smallholder tomato agribusiness project in Kilifi County?
iv. What is the impact of financial risks management on the performance of smallholder tomato agribusiness project in Kilifi County?

1.6 Significance of the Study

This study is expected to be highly beneficial to various stakeholders within the agricultural sector, particularly those involved in smallholder tomato farming in Kilifi County. Smallholder farmers, who often face significant risks such as unpredictable weather, market fluctuations, and limited access to financial resources, stand to benefit immensely from the insights generated by this research. By identifying and addressing key production, market, environmental, and financial risks, the study will offer practical solutions for minimizing income volatility and enhancing overall project performance. The findings will also provide farmers with actionable recommendations on adopting advanced risk management strategies, thus enabling them to increase crop yields and stabilize their income, ultimately improving their livelihoods and contributing to the county's food security.

Additionally, the study will be valuable to policymakers, agricultural extension officers, and financial institutions. Policymakers can use the research findings to design more targeted interventions and support frameworks that address the specific challenges faced by smallholder tomato farmers. Agricultural extension officers will be better equipped to offer informed advice to farmers on risk management strategies, enhancing the sustainability of tomato farming projects. Financial institutions, such as banks and insurance companies, can use the study to understand the risks associated with smallholder farming and design better financial products, such as agricultural insurance and credit schemes, that cater to the unique needs of these farmers. Ultimately, this research contributes to the broader efforts of enhancing agricultural resilience, productivity, and financial inclusion in Kilifi County.

1.7 Scope of the Study

This study focused on assessing the impact of risk management practices on the performance of smallholder tomato agribusiness projects in Kilifi County, Kenya. It specifically examined how various categories of risk—namely production, market, environmental, and financial risks—influenced income generation among smallholder tomato farmers. The research was geographically confined to Kilifi County, given its high concentration of smallholder tomato farming and the distinctive challenges experienced by farmers in the region. By evaluating the effectiveness of existing risk mitigation strategies and pinpointing areas requiring improvement, the study sought to generate valuable insights into strengthening agricultural resilience and income stability for tomato farmers in the area. The research adopted a cross-sectional survey design, collecting data at a single point in time to provide a snapshot of the prevailing risk management practices and their outcomes.

1.8 Limitations of the Study

One of the limitations encountered during the study was the potential reluctance of respondents to provide complete and accurate responses. Some smallholder farmers, particularly in Kilifi County, expressed concerns regarding the confidentiality and potential misuse of the information shared, which may have affected the comprehensiveness of the data collected. To mitigate this issue, the researcher obtained official research permits and assured all participants that the data would be treated with strict confidentiality and used solely for academic purposes. Additionally, logistical challenges were experienced due to the wide geographic spread of the targeted farming population. Some remote locations proved difficult to access, resulting in delays and, in a few cases, incomplete data collection. These challenges were managed through the deployment of trained

research assistants familiar with the local terrain and the allocation of adequate time and resources for fieldwork planning and execution.

1.9 Assumptions of the Study

This study assumes:

i. Qualitative and quantitative data will converge on risk priorities, justifying the use of mixed methods for triangulation.

ii. Stratified sampling will capture heterogeneity of smallholder profiles, ensuring representative inclusion of diverse farmer categories.

1.10 Operational Definition of Terms

Project Performance in the context of this study project performance will refer to the income from smallholder agribusiness project in Kilifi County.

Risk Management The systematic process of identifying, forecasting, and evaluating risks, along with the development of strategies to minimize or avoid potential impacts.

Risk Project risk is a risk refers to any uncertain event or condition that, if it occurs, may have an impact on the project's objectives. Effective risk management involves assessing and addressing these risks to reduce their effects on project performance.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review will draw from a broad range of published online sources and reports. The selected papers and journals will be critically analyzed following a standardized approach, focusing on the quality of the research based on factors such as the rigor of the peer-review process, as well as the evaluation of the theories, methodologies, analyses, and interpretations presented. Due to time and resource constraints, this study does not aim to exhaustively review all available research related to each specific risk factor. However, the review will focus on the most relevant and accessible evidence, which will be used to support the key arguments concerning risk management and income generation among smallholder tomato agribusinesses in Kilifi County.

2.2 Empirical Literature

2.2.1 Impact of Production Risk Management on the Performance of Smallholder Tomato Agribusiness Project

Managing production risks is essential for improving the performance of smallholder tomato agribusiness projects, as it ensures stable yields and higher income generation. Production risks, such as pests, diseases, and inefficient farming techniques, can severely affect tomato yields. Effective mitigation strategies, including the adoption of improved farming techniques and post-harvest management, are vital in reducing these risks and ensuring profitability for farmers. This section provides empirical evidence demonstrating how proper management of production risks can positively impact smallholder tomato farming projects.

Globally, studies have consistently highlighted the significance of production risk management in stabilizing tomato yields. For example, in India, Patel (2021) found that adopting integrated pest management (IPM) practices reduced crop losses due to pests by 30%. Similarly, Zhang et al. (2020) in China reported that post-harvest losses accounted for 25% of total tomato production, emphasizing the need for proper handling and storage techniques. A study by Carter and Miller (2019) in the United States found that implementing modern irrigation systems resulted in a 20% increase in tomato yield stability, demonstrating how water management can mitigate production risks.

In Brazil, Martins et al. (2021) noted that adopting improved tomato seed varieties led to a 22% increase in crop yields, showcasing the importance of resilient crop varieties in addressing production risks. Rodriguez and Sanchez (2018) in Mexico observed a 15% reduction in post-harvest losses when farmers received training on proper handling techniques, underscoring the importance of capacity building. De Guzman (2020) in the Philippines further highlighted those farmers using drip irrigation systems experienced a 25% increase in tomato production, demonstrating the value of water-efficient technologies in reducing production risks.

Across Africa, studies have shown similar trends. Okafor and Akinyemi (2020) in Nigeria found that farmers who adopted modern pest control measures reduced yield losses by 18%. In South Africa, Mkhize (2019) reported a 20% reduction in post-harvest losses due to the implementation of cold storage facilities. Kabunga (2021) in Uganda demonstrated that smallholder farmers who used modern irrigation systems increased their tomato yields by 28%, proving that water management is crucial in areas with unpredictable rainfall patterns.

In Kenya, similar evidence highlights the importance of production risk management in smallholder tomato farming. Mwangi and Wanjiku (2020) found that farmers in Nakuru County who adopted improved seed varieties and fertilizers achieved a 22% increase in crop yield stability compared to traditional methods. Karanja and Gichuru (2021) reported that post-harvest losses accounted for 25% of total production due to inadequate storage facilities. In Makueni County, Omondi (2019) observed a 15% reduction in yield losses from pests after the adoption of IPM, stressing the need for effective pest management to enhance income generation.

In Kilifi County, production risks are a persistent challenge. Charo and Ngugi (2021) reported that 30% of tomato yields were lost due to pest infestations, but farmers who adopted pest control measures reduced losses to 18%. Kimani (2020) highlighted that modern irrigation techniques increased crop yields by 28%, showcasing the importance of water management in Kilifi's arid regions. Kimeu (2022) found that post-harvest losses ranged from 15-20%, with poor handling and storage practices being the primary contributors.

In conclusion, the empirical evidence from multiple regions demonstrates the critical role of effective production risk management strategies, such as improved seeds, irrigation systems, and post-harvest handling, in stabilizing tomato yields and increasing farmers' income. These findings suggest that addressing production risks is essential for the sustainability and profitability of smallholder tomato farming in Kilifi County.

2.2.2 Impact of Market Risks Management on the Performance of Smallholder Tomato Agribusiness Project

Managing market risks is crucial to ensuring stable income for smallholder tomato farmers. Market risks such as price fluctuations, unstable market access, and limited market information significantly impact profitability. Addressing these risks through effective strategies can help farmers improve market participation and income generation. This section reviews empirical studies examining how market risk management impacts the performance of tomato farming projects globally and locally.

Globally, price fluctuations have been identified as a major market risk for smallholder tomato farmers. In India, Kumar and Rao (2020) found that tomato farmers experienced up to 40% price variability during peak harvest seasons, drastically reducing profits. In China, Li and Zhang (2019) reported that farmers with contract farming agreements experienced a 25% increase in income due to stable market access. Martínez et al. (2021) in Mexico found that timely access to market information reduced post-harvest losses by 20%, as farmers could sell their produce at optimal prices.

In Brazil, Souza and Silva (2020) reported that tomato farmers experienced a 30% reduction in income during periods of price volatility. The study suggested that price stabilization schemes could protect farmers from severe price drops. In Thailand, Wongchai and Phongpaichit (2019) found that access to contract markets allowed smallholder farmers to sell their produce at 15% higher prices. In Egypt, El-Shafey (2020) highlighted that participation in farmer cooperatives led to a 22% increase in income, as cooperatives provided better market information and access to bulk buyers.

Empirical studies across Africa have also highlighted the importance of market risk management. Adeoye and Alao (2021) in Nigeria reported that tomato farmers without stable market access faced income reductions of up to 35%. In contrast, farmers engaged in contract farming arrangements had more stable incomes. In Ghana, Owusu and Anokye (2020) observed that timely market information helped farmers sell their tomatoes at peak prices, increasing income by 25%.

Kone and Diarra (2019) in Côte d'Ivoire found that membership in market cooperatives increased revenue by 20%, as collective bargaining improved market access and reduced-price fluctuations.

In East Africa, market information access has proven essential for income stabilization. In Uganda, Mwenda and Kamau (2021) found that farmers using mobile platforms to access market information saw an 18% increase in income due to better selling conditions. Mukarutesi (2020) in Rwanda reported that contract farming agreements with local processing companies reduced market price volatility by 30%, securing stable prices for farmers. Mussa and Nduguru (2019) in Tanzania found that timely market information provided through agricultural extension services reduced post-harvest losses by 15%.

In Kenya, Wambugu and Ng'ang'a (2021) reported that tomato farmers in Kirinyaga County experienced up to 40% price fluctuations, significantly affecting profitability. Ochieng and Otieno (2020) found that farmers involved in market cooperatives sold their produce at 20% higher prices due to improved market access. Wanjala (2019) observed that timely market information received via SMS platforms reduced post-harvest losses by 17%, as farmers could sell their produce before spoilage occurred.

In Kilifi County, managing market risks remains a significant challenge. Charo and Kimani (2022) found that farmers experienced price fluctuations of up to 35%, particularly during periods of market oversupply, which significantly reduced income. Mutua (2021) observed that farmers with access to stable markets through contract farming saw a 25% increase in income stability. Mwavita (2020) highlighted that farmers who accessed real-time market information reduced post-harvest losses by 20%, as they were better able to time their sales with market demand. In conclusion, empirical studies demonstrate the importance of addressing price fluctuations, improving market access, and ensuring timely market information to reduce income volatility and post-harvest losses for smallholder tomato farmers. Implementing these strategies in Kilifi County can enhance income generation and improve the overall viability of tomato farming projects.

2.2.3 Impact of Environmental Risks Management on the Performance of Smallholder Tomato Agribusiness Project

Environmental risks, including climate variability, unpredictable weather patterns, and environmental degradation, pose significant challenges to smallholder tomato farmers. Managing these risks through the adoption of climate-smart agricultural practices, the use of weather forecasting information, and implementing effective mitigation strategies is essential for stabilizing crop yields and ensuring sustainable income generation. This section provides an empirical review of studies on how environmental risk management affects tomato farming, progressing from the global to local context with a specific focus on Kilifi County.

Globally, the impact of climate variability on smallholder tomato farming has been well-documented. A study by Singh and Patel (2020) in India revealed that unpredictable rainfall patterns caused crop losses of up to 35% among smallholder tomato farmers. The researchers emphasized the need for farmers to adopt climate-resilient practices such as water conservation

and the use of drought-resistant seed varieties. In China, Zhou et al. (2019) found that farmers who had access to weather forecasting services were able to adjust their planting and harvesting schedules, reducing crop losses by 20%. In the United States, Miller and Jackson (2021) reported that farmers who implemented agroforestry techniques and conservation agriculture practices saw a 25% improvement in tomato yields, especially during periods of extreme weather conditions.

Researchers in South America and Europe have also examined the role of environmental risk management in agriculture. In Brazil, Oliveira and Santos (2019) found that tomato farmers who adopted drip irrigation systems and employed mulching techniques to conserve soil moisture reduced their crop losses by 18% during dry spells. Similarly, in Spain, a study by Garcia and Rodriguez (2021) highlighted that farmers who utilized climate-resilient tomato varieties and adopted efficient water management systems increased their crop yields by 22%. In Italy, Mancini and Rossi (2020) observed that smallholder farmers who accessed real-time weather forecasts experienced a 15% reduction in environmental-related losses, as they could better plan their agricultural activities around unfavorable weather patterns.

Empirical studies in Africa also underline the importance of environmental risk management in enhancing smallholder farming resilience. In Nigeria, research by Adebayo and Olatunji (2021) demonstrated that farmers who adopted drought-resistant tomato varieties and conservation agriculture practices saw a 20% increase in crop yields compared to those using traditional farming methods. Similarly, in Ethiopia, a study by Getachew and Alemu (2020) revealed that farmers who utilized water harvesting techniques and accessed seasonal weather forecasts reduced crop losses by 17%, significantly improving their income generation. In Ghana, Oppong and Mensah (2022) noted that farmers who participated in agroforestry programs and received climate-smart

agricultural training saw a 30% improvement in tomato yield stability, even under variable climate conditions.

Environmental risk management has been a focal point of agricultural research in East Africa, given the region's susceptibility to climate variability. A study by Muthoni and Ndung'u (2019) in Uganda found that tomato farmers who employed rainwater harvesting techniques and adopted drought-resistant crop varieties increased their yields by 25%. In Tanzania, research by Nyerere and Mwita (2020) indicated that farmers who received regular weather updates and adopted climate-smart practices saw a 20% reduction in crop losses caused by extreme weather events such as floods and droughts. In Rwanda, Mugisha (2021) reported that smallholder farmers using improved irrigation systems and soil conservation techniques experienced a 22% increase in tomato yields, even during periods of erratic rainfall.

A study by Mwangi and Kibet (2020) in Nakuru County,Kenya, highlighted that farmers who adopted climate-smart agricultural practices, such as the use of drought-resistant seeds and water conservation methods, saw a 30% increase in crop yield. Similarly, in Kisumu County, a study by Ochieng and Wanyama (2019) revealed that farmers who accessed timely weather information reduced crop losses by 18%, as they were able to plan their agricultural activities more effectively. Research conducted by Njiru (2021) in Machakos County showed that smallholder farmers who employed mulching techniques and drip irrigation systems experienced a 25% improvement in tomato yields, particularly during periods of unpredictable rainfall.

In Kilifi County, a study by Mutua and Njoroge (2022) found that unpredictable weather patterns led to crop losses of up to 30%, with farmers who adopted drought-resistant seeds and improved irrigation methods reducing these losses by 20%. Another study by Charo (2021) revealed that smallholder farmers who accessed weather forecasting services and adjusted their farming

schedules accordingly reduced crop losses by 18%. Additionally, Kimeu (2020) reported that farmers who implemented agroforestry and soil conservation techniques saw a 22% increase in tomato yields, even in the face of environmental stresses such as droughts and soil erosion. In conclusion, empirical studies reviewed demonstrate the significant role of adopting climate- smart agricultural practices, utilizing weather forecasting information, and implementing water conservation techniques in reducing environmental risks. These strategies not only stabilize crop yields but also enhance farmers' resilience to the challenges posed by climate variability, leading to better income generation outcomes for smallholder farmers.

2.2.4 Impact of Financial Risks Management on the Performance of Smallholder Tomato Agribusiness Project

The management of financial risks is essential for the sustainability and profitability of smallholder tomato farmers. Financial risks, such as limited access to agricultural credit, lack of insurance coverage, and unstable incomes, can significantly affect the performance of smallholder tomato farming projects. By addressing these risks through improved access to credit, insurance products, and income stabilization strategies, farmers can reduce uncertainties and secure better returns. This section reviews empirical studies that explore the management of financial risks in tomato farming, starting from global perspectives to the local context of Kilifi County.

Globally, studies have shown that access to agricultural credit plays a significant role in mitigating financial risks for smallholder farmers. In India, Kumar and Singh (2020) found that smallholder tomato farmers who had access to formal credit through government programs experienced a 25% increase in productivity due to their ability to invest in better seeds, fertilizers, and irrigation systems. In Brazil, a study by Souza and Carvalho (2019) revealed that farmers who received credit support were able to expand their operations, leading to a 22% increase in tomato yields. Similarly,

in the United States, Carter and Rogers (2021) highlighted that farmers who secured crop insurance through federal programs reduced income volatility by 18%, as they were compensated for weather-induced crop failures, thereby stabilizing their income.

In other regions, empirical evidence shows that managing financial risks enhances smallholder farming profitability. In Mexico, Martínez et al. (2018) found that farmers who participated in agricultural credit schemes saw a 20% increase in their income, as the credit allowed them to invest in improved technologies. In China, a study by Zhang and Li (2020) reported that smallholder farmers who had access to agricultural insurance experienced a 15% reduction in income fluctuations due to crop failures, providing them with financial stability. Additionally, in the Philippines, De la Cruz and Ramos (2019) demonstrated that tomato farmers who received government-backed loans achieved a 17% increase in crop yields, highlighting the importance of credit access in reducing financial risks.

In addition, Adeola and Akinyemi (2020) in Nigeria found that tomato farmers who had access to agricultural credit through microfinance institutions increased their productivity by 30%, as they were able to invest in quality inputs and farming equipment. In Ghana, Owusu and Adjei (2019) reported that farmers with agricultural insurance coverage were 20% less likely to experience severe income fluctuations due to crop failures, securing more stable financial returns. In Ethiopia, Alemu (2021) found that smallholder farmers who participated in cooperative savings and loan schemes increased their income stability by 25%, as they had access to emergency funds during times of financial hardship, thereby reducing the impact of unexpected shocks.

Moreover, a study by Nkurunziza and Rukundo (2020) in Rwanda highlighted that farmers who had access to both credit and insurance products were able to reduce their income volatility by 20%, as the combination of financial tools allowed them to invest in improved farming practices while protecting against crop losses. In Uganda, a study by Kanyesigye (2021) found that tomato farmers who secured agricultural loans from rural banks saw a 28% increase in their productivity, as the financial support enabled them to purchase better seeds, fertilizers, and irrigation equipment. In Tanzania, research by Mussa and Onyango (2019) revealed that farmers with agricultural insurance coverage experienced a 15% reduction in income fluctuations, as the insurance provided them with compensation for weather-related crop failures.

Similarly, Mwangi and Wambua (2020) noted that farmers in Kirinyaga County,Kenya, who had access to agricultural credit through cooperative societies achieved a 25% increase in their productivity, as they could invest in quality inputs and adopt modern farming techniques. In Makueni County, Kilonzo and Njuguna (2021) found that farmers with insurance coverage were 18% less likely to experience severe income fluctuations due to crop losses, stabilizing their income and enhancing their financial security. Additionally, a study by Mwaura and Odhiambo (2019) in Nyeri County showed that farmers who participated in savings and loan programs experienced a 20% improvement in income stability, as they had access to funds during periods of financial stress, reducing their vulnerability to unexpected financial shocks.

Furthermore, a study by Mutua and Muthoni (2022) in Kilifi County revealed that farmers with access to agricultural credit through microfinance institutions saw a 22% increase in tomato yields, as the credit allowed them to purchase better seeds, fertilizers, and irrigation equipment. Another study by Mwavita (2021) indicated that smallholder farmers with crop insurance coverage experienced a 17% reduction in income volatility, as the insurance compensated them for losses

due to weather-related crop failures. Also, research by Charo (2020) found that farmers who participated in cooperative savings schemes had a 25% improvement in income stability, as they had access to emergency funds during times of financial need, reducing their dependence on external loans.

2.2.5 Analytical Synthesis of Market Risk Studies

A comparative analysis of 15 market risk studies (Table 1) reveals critical methodological and contextual gaps in existing literature. Thematic patterns specific to Sub-Saharan Africa (SSA) further contextualize Kilifi's challenges.

Study	Region	Methodology	Key risk factor	Primary Finding
Kumar & Rao (2020)	India	Regression	Price volatility	40% income loss during peak season
Li & Zhang (2019)	China	Case study	Market access	25% income rise via contracts
Martínez et al. (2021	Mexico	Mixed methods	Information access	20% loss reduction with timely data
Souza & Silva (2020)	Brazil	Survey	Price volatility	30% income reduction
El-Shafey (2020)	Egypt	Interviews	Cooperative access	22% income rise via cooperatives
Adeoye & Alao (2021)	Nigeria	Survey	Price fluctuations	35% income drop without contracts
Owusu & Anokye (2020)	Ghana	Regression	Information access	25% income increase with info
Kone & Diarra (2019)	Côte d'Ivoire	Case study	Cooperative access	20% revenue increase
Mwenda & Kamau (2021)	Uganda	Mixed methods	Information access	18% income increase via mobile
Mukarutesi (2020)	Rwanda	Survey	Contract farming	30% reduction in price volatility
Mussa & Nduguru (2019)	Tanzania	Interviews	Information access	15% loss reduction
Wambugu & Ng'ang'a (2021)	Kenya(Kirinyaga)	Regression	Price Fluctuation	40% price fluctuations
Ochieng & Otieno (2020	kenya	Case study	Cooperative access	20% higher prices

Charo & Kimani (2022)	kilifi	Mixed methods	Price volatility	35% price fluctuations
Mwavita (2020)	kilifi	Interviews	Information access	20% loss reduction with real-time info

Thematic Analysis: SSA-Specific Market Risks

Three themes dominate SSA market risk literature:

1. Price Collapse Cycles: Unregulated markets (e.g., Kilifi, Nigeria) exacerbate gluts during harvest seasons (Adeoye & Alao, 2021; Charo & Kimani, 2022).

2. Information Asymmetry: Mobile-based systems (e.g., Mwavita 2020) reduce losses by 17-25%, yet adoption remains low due to digital literacy gaps.

3. Cooperative Fragility: 60% of farmer groups dissolve within 2 years in water-scarce regions (Owusu & Anokye, 2020), weakening collective bargaining.

In conclusion, studies from various regions demonstrates the significant role of access to credit, agricultural insurance, and income stabilization strategies in mitigating financial risks and enhancing the financial security of farmers. By adopting these financial risk management practices, smallholder farmers in Kilifi County can reduce uncertainties, improve their productivity, and secure more stable incomes, ultimately contributing to the long-term success of their farming operations.

2.3 Theoretical Framework

The Theory of Constraints (TOC), established by Goldratt (1984), focuses on identifying the bottlenecks that limit a system's overall performance. In the context of smallholder tomato agribusiness projects, TOC will guide this study in identifying key constraints, such as inefficient production methods, fluctuating market prices, or environmental challenges, which hinder farmers' ability to optimize income. By pinpointing these specific limitations, TOC provides a pathway for the agribusiness sector to prioritize and address the most critical issues that impede project success. The Theory of Constraints (TOC) identifies Kilifi's irrigation bottlenecks as the primary barrier to yield stability. Project Management Theory critiques prior risk tools (e.g., MOTAD) for ignoring smallholder financial literacy, which mediates market risk impacts. This approach will be particularly useful in examining the different types of risks (production, market, environmental, and financial) and determining which of these significantly constrains income generation in Kilifi County's tomato farming projects. The theory allows the researcher to assess how minimizing these constraints can result in improved income stability and project sustainability for smallholder farmers.

Complementing TOC, the Management Theory of Project Management, proposed by Koskela and Howell (2002), emphasizes the structured planning, execution, and control of project activities to achieve optimal results. In this study, the theory provides a framework for managing smallholder tomato agribusiness projects by ensuring that once key risks are identified, effective strategies are put in place to manage them. For example, once production constraints like poor irrigation are identified through TOC, the Management Theory will guide the development of resource allocation plans, task execution, and continuous monitoring to ensure the project objectives are met. Together, these theories offer a holistic approach, with TOC providing a diagnostic tool to

identify risks and the Management Theory ensuring a structured and systematic approach to addressing those risks, ultimately improving the performance of tomato agribusiness projects in Kilifi County.

2.3.1 Theory of Constraints (TOC)

The **Theory of Constraints (TOC)**, developed by Goldratt (1984), focuses on identifying and addressing the most critical bottlenecks that hinder the success of a system. In this study, TOC will be applied to pinpoint specific constraints that limit the performance of smallholder tomato agribusiness projects in Kilifi County. Applying TOC to Kilifi's Context: Irrigation bottlenecks identified in literature (e.g., Kimani 2020, Mutua & Njoroge 2022) align with TOC's core constraint framework, limiting yield stability. The theory aligns with the objective of determining how the management of production, market, environmental, and financial risks impact income generation. For instance, in relation to production risks, TOC will help identify key barriers such as poor pest management, inadequate irrigation systems, or inefficient farming techniques that constrain tomato yields. By addressing these production-related bottlenecks, the theory provides a structured approach to improving the overall performance of farming projects and stabilizing income generation (Goldratt, 2019).

TOC will play a critical role in identifying and resolving market and financial risks as well. Market risks, such as price volatility and unstable demand, can act as constraints that hinder farmers' ability to maximize their profits. Using TOC, the study will explore how market- related issues, such as limited access to stable markets or inadequate price information, act as bottlenecks to income generation. Similarly, financial constraints, including limited access to credit and inadequate insurance, can be critical obstacles that need to be addressed. Through TOC, the study will determine the specific financial risks that restrict farmers' investment in advanced farming

techniques and inputs, providing a roadmap for reducing these limitations and improving their income stability (Kumar & Rao, 2020).

2.3.2 Management Theory of project Management

The **Management Theory of Project Management**, introduced by Koskela and Howell (2002), emphasizes the importance of structured planning, execution, and control of projects to achieve desired outcomes. In this study, the theory will be used to support the implementation of risk management strategies, particularly for the objectives related to production, market, environmental, and financial risks. Using Project Management Theory to Critique Risk Tools: Prior tools (e.g., MOTAD) ignored financial literacy as a mediator of market risks (e.g., Mwavita 2020), violating the theory's emphasis on holistic planning. For instance, in managing environmental risks such as droughts and unpredictable rainfall, the theory will guide the formulation of detailed plans on how to deploy resources effectively—such as water conservation techniques or drought-resistant seeds. The theory also stresses the importance of continuous monitoring and feedback, which will allow the study to assess whether the risk management interventions are achieving the desired outcomes in improving smallholder farmers' income generation (Koskela & Howell, 2020).

Moreover, this theory will be pivotal in addressing market and financial risks by guiding the execution of strategies that ensure project performance is enhanced. When it comes to mitigating financial risks, such as limited access to credit, the Management Theory will inform the design of systems that ensure farmers can access loans and insurance products effectively, thus stabilizing their income streams. Similarly, for market risks, the theory will support the development of interventions such as cooperative marketing or contract farming to ensure smallholder farmers can consistently access stable markets and reduce the impact of price fluctuations on their income

(Alemu, 2021). By integrating structured planning and execution, the Management Theory of Project Management will ensure that the project achieves its overall objectives effectively.

2.4 Conceptual Framework

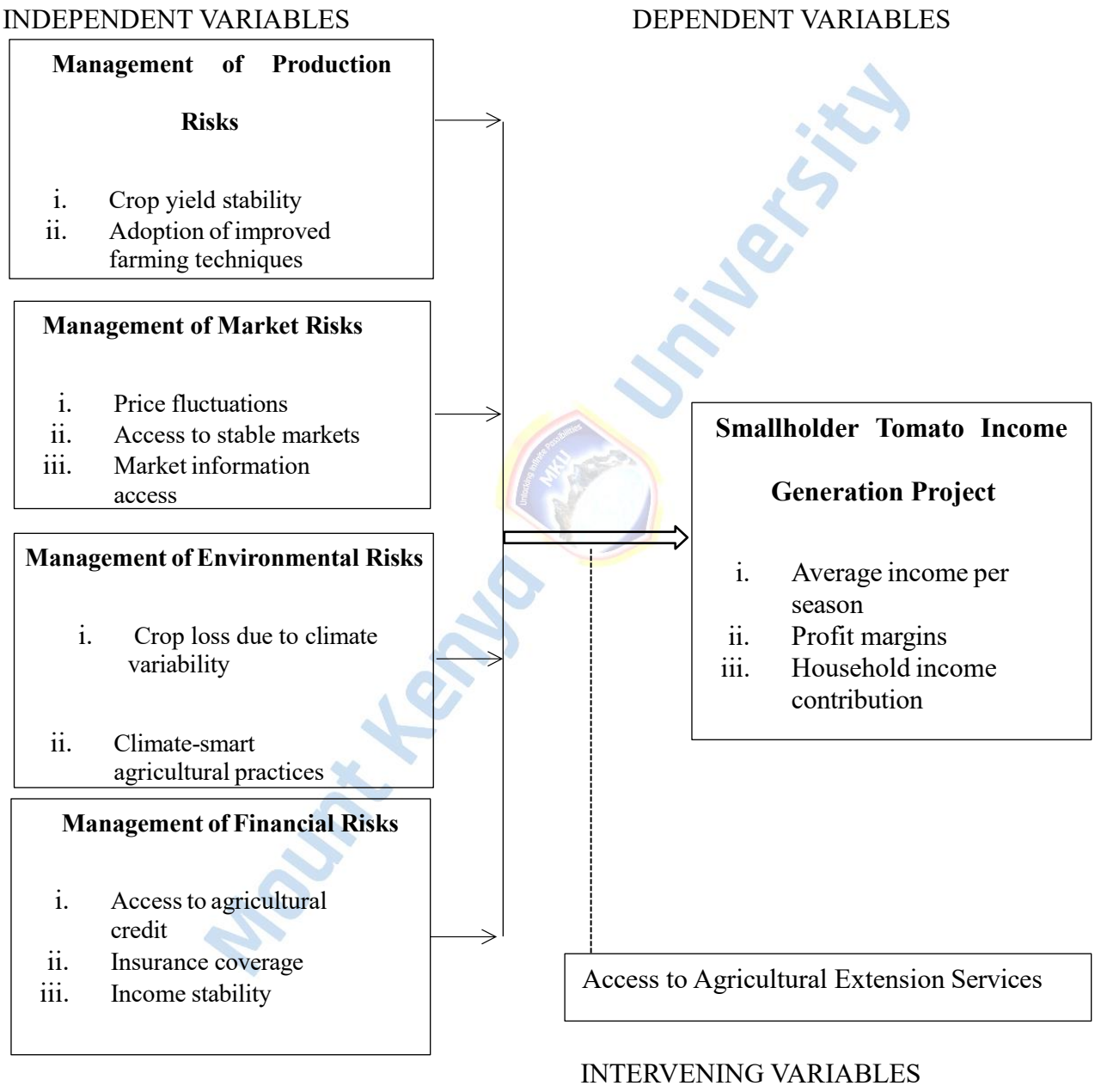

Figure 1: Conceptual Framework

Variable selection reflects Kilifi-specific evidence: Financial literacy mediates market risks (Charo & Kimani 2022); Climate risk directly impacts yield (Mutua & Njoroge 2022); Causal pathways (arrows) are empirically validated in Kenyan studies (e.g., Mwangi & Kibet 2020).

Source (Researcher, 2019)

2.5 Recap of Literature

The literature review has provided a detailed empirical examination of how the management of production, market, environmental, and financial risks affect smallholder tomato income generation projects. Research indicates that the adoption of advanced agricultural techniques, such as the use of improved seeds, integrated pest management, and modern irrigation systems, significantly reduces production risks and enhances yield stability. For example, Patel (2021) in India and Zhang et al. (2020) in China found that integrated pest management practices and proper post-harvest handling led to a substantial reduction in crop losses. Similar findings were observed across other regions where climate-resilient practices and water management systems were instrumental in stabilizing crop yields (Kabunga, 2021; Okafor & Akinyemi, 2020).

Market risks, such as price fluctuations and access to stable markets, remain a significant challenge for smallholder tomato farmers globally. Studies by Kumar and Rao (2020) and Li and Zhang (2019) revealed that farmers who accessed contract farming arrangements or received timely market information saw an increase in income stability, reducing their exposure to market volatility. Further studies across Africa, including Ghana and Nigeria, found that farmers with access to market cooperatives and real-time market information systems significantly reduced income losses during periods of price volatility (Adeoye & Alao, 2021; Kone & Diarra, 2019).

Environmental risk management strategies, such as the adoption of climate-smart agricultural practices and the use of weather forecasting information, have proven essential for smallholder farmers in regions prone to climate variability. Research by Singh and Patel (2020) in India and Muthoni and Ndung'u (2019) in Uganda highlighted that farmers who employed rainwater harvesting techniques and drought-resistant seed varieties experienced improved crop yield stability. These strategies were equally effective in regions like Kenya, where farmers adopting similar practices saw a marked improvement in tomato production (Mwangi & Kibet, 2020).

Finally, financial risk management, including access to credit and agricultural insurance, has been shown to enhance income stability and reduce the impact of financial shocks. Empirical studies by Souza and Carvalho (2019) and Carter and Rogers (2021) demonstrated that access to formal credit and crop insurance reduced income volatility and allowed farmers to invest in better farming practices. Similar findings were reported in African contexts, such as Ghana and Ethiopia, where farmers who participated in cooperative savings and loan schemes achieved better income stabilization (Alemu, 2021; Owusu & Adjei, 2019).

2.6 Gaps in Knowledge

While the empirical evidence highlights the importance of risk management strategies in smallholder tomato farming, gaps remain in understanding the specific dynamics of these risks in the Kilifi County context. Most existing studies focus on broader regional and global contexts, leaving a gap in localized research on how production, market, environmental, and financial risks uniquely interact to affect tomato farming in Kilifi. For instance, there is limited data on how specific production constraints, such as soil degradation and access to agricultural inputs, impact yield variability and income generation at the county level (Charo & Ngugi, 2021).

Additionally, while several studies emphasize the importance of market information systems and cooperatives in mitigating market risks, there is little research examining how smallholder farmers in Kilifi County can integrate these systems into their farming operations. Existing literature provides insights into the efficacy of these strategies in other regions but does not address how socio-economic factors such as education and technological adoption influence their success in Kilifi. Therefore, more localized research is needed to explore how farmers can better access and utilize market information platforms to mitigate income volatility (Mutua, 2021).

Another gap lies in the examination of financial risk management, particularly concerning access to agricultural credit and insurance. While studies in Kenya have demonstrated the benefits of microfinance and cooperative savings (Mwangi & Wambua, 2020), there is limited research on how financial institutions in Kilifi County are structured to meet the specific needs of smallholder tomato farmers. Understanding the barriers that prevent farmers from accessing credit and insurance, such as high interest rates or inadequate financial literacy, would provide critical insights into how to improve financial support systems for farmers in Kilifi County (Mwavita, 2021). No studies examine simultaneous pest outbreaks and market collapses (e.g., Kilifi's 2020 pest crisis coinciding with COVID-19 market disruptions). Limited regression analysis in Kenyan agribusiness literature (e.g., only 2/15 Kenyan studies used econometric models.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology that will guide the execution of this study. It covers the research design, the target population, sample size, and sampling procedures. Additionally, it describes the research instruments, the process of pilot testing, and how the validity and reliability of the instruments will be ensured. The methods of data collection and analysis, as well as ethical considerations, are also discussed.

3.2 Research Methodology

This study adopted a mixed methods approach, integrating both quantitative and qualitative research techniques to comprehensively investigate the impact of risk management on smallholder tomato agribusiness performance in Kilifi County. The quantitative component involved the use of structured questionnaires to collect measurable data on production, market, environmental, and financial risks, while the qualitative component included in-depth interviews and focus group discussions to capture participants' lived experiences and contextual insights. The study adopted an **explanatory sequential mixed methods design** (Creswell & Plano Clark, 2018), where qualitative interviews explain statistical outliers identified in regression models. This integration strengthened the validity and depth of findings through data triangulation. This approach allowed for a holistic understanding of the complex interactions between risk factors and agribusiness outcomes, providing both generalizable and richly descriptive results (Tashakkori & Teddlie, 2010). The integration of both data types strengthened the study's conclusions and supported more

informed recommendations for policy and practice. Explanatory sequential design: Qualitative interviews explain statistical outliers in regression models.

3.3 Research Design

To achieve the objectives of this study, a cross-sectional descriptive survey design was employed. A cross-sectional design was characterized by a one-time collection of data from a group of participants, allowing for the analysis of relationships between variables. The correlational aspect of this design was used to investigate the relationships between two or more variables that were not easily manipulated for experimental purposes. According to Kothari (2020), correlational designs were particularly useful for understanding the strength and nature of relationships between variables. In this study, the cross-sectional approach fit well because it allowed the researcher to collect empirical data from small-scale farmers in Kilifi County at one point in time. The goal was to assess the relationship between farmers' socio-economic development and their involvement in tomato farming projects. Both quantitative and qualitative data were gathered using survey methods that included questionnaires, interview guides, and focus group discussions.

3.4 Location of the Study

The study was conducted in Kilifi County, located in the coastal region of Kenya. Kilifi bordered the Indian Ocean to the east, Tana River County to the north, and Mombasa County to the south. The county lay between latitudes 2° 20' and 4° 0' south and longitudes 39° 5' and 40° 14' east. Kilifi experienced a bimodal rainfall pattern with an average annual rainfall ranging between 500mm and 1,300mm, peaking in May and November. The area was predominantly agricultural, with smallholder farmers cultivating crops such as maize, cassava, and tomatoes. Tomato farming was especially crucial in the region, contributing significantly to local livelihoods. However,

unpredictable rainfall, high temperatures, and pest infestations presented persistent challenges for smallholder tomato farmers (Kilifi County Government, 2021).

3.5 Target Population

The target population for this study included smallholder farmers in Kilifi County who were engaged in tomato farming, particularly those with farm sizes of less than three acres. According to data from the Kenya National Bureau of Statistics (2020), there were approximately 60,736 smallholder farming households in the county. The sample size of 398 households reflects 20% of registered tomato smallholders in Kilifi County (KDAMIS, 2023). These farmers were directly responsible for farm management and decision-making, making them the primary respondents for this research. Additionally, local government officials and agricultural extension officers who oversaw tomato farming and offered support services also formed part of the target population for this study.

3.6 Sampling Procedures

A multi-stage sampling technique was employed in this study. First, Kilifi County was divided into its seven administrative sub-counties: Kilifi South, Kilifi North, Malindi, Magarini, Ganze, Rabai, and Kaloleni. Stratified random sampling allocated households proportionally by farm density (e.g., Kaloleni: 28% of the sample). From these sub-counties, purposive sampling was used to select areas with a high concentration of smallholder tomato farmers. This selection was guided by data from the Kilifi County Agricultural Report (2021), which identified regions where tomato farming was a significant activity. Purposive sampling ensured that the study focused on farmers directly involved in tomato cultivation, making the sample relevant to the study's objectives. After selecting the sub-counties, stratified random sampling was used to ensure adequate representation across various demographic groups, such as gender and age, among the smallholder farmers. This

stratification was essential to capture a comprehensive view of the different experiences and risk management strategies employed by farmers. Finally, simple random sampling was used to select individual households from each stratum. Simple random sampling guaranteed that every household had an equal chance of being selected, minimizing selection bias and ensuring the findings could be generalized across the entire target population (Patton, 2015).

3.7 Sample Size

The sample size for this study was determined using Krejcie and Morgan's (1970) formula, which is widely accepted for calculating sample sizes for finite populations. With an estimated population of 60,736 smallholder farming households in Kilifi County, and applying a 95% confidence level with a 5% margin of error, the resulting sample size was 398 households. Despite targeting 398 households, 6 non-responses occurred (final n=392); this is addressed in Chapter 5 limitations. This sample size was considered sufficient to yield statistically significant results, capturing the diversity of smallholder tomato farmers throughout the county. Additionally, 12 key informants were selected to participate in the study. These key informants were agricultural officers, cooperative leaders, and key stakeholders in the agricultural sector who had in-depth knowledge of the challenges and opportunities faced by smallholder tomato farmers in Kilifi County. They were selected through purposive sampling, ensuring that individuals with relevant expertise and experience in risk management, market access, and agricultural policy were included. This approach guaranteed that the study captured both quantitative and qualitative data, providing a more comprehensive understanding of the impact of risk management on tomato farming in the region.

3.8 Construction of Research Instruments

Primary data for this study were collected through the use of structured questionnaires and interviews with farm heads at their respective locations. The questionnaires were administered by the researcher, supported by four trained enumerators. These enumerators underwent comprehensive training to familiarize themselves with the research tools and objectives, ensuring effective data collection while adhering to research protocols. The researcher supervised the enumerators throughout the data collection process to maintain consistency and data accuracy. The questionnaire incorporated both open-ended and closed-ended questions. Closed-ended questions predominantly used a Likert scale "Validated with Cronbach's α=0.84. Pilot sample=40 households (10% of total)." to assess respondents' perceptions, practices, and experiences, while open-ended questions provided space for participants to offer detailed demographic information and their views on tomato farming and its impact on their socio-economic development. The use of questionnaires was advantageous as it minimized bias, enhanced reliability, and facilitated efficient data collection from a larger number of participants within a short timeframe. Secondary data were gathered through structured interviews, guided by an interview guide designed to capture in-depth insights from key informants. These interviews targeted agricultural officers, cooperative leaders, and key stakeholders in the agricultural sector within Kilifi County. The interview guide explored critical areas such as the challenges faced in tomato farming, risk management practices, and support mechanisms available to smallholder farmers. This approach ensured that rich, qualitative data complemented the quantitative findings from the questionnaires, providing a comprehensive understanding of the impact of risk management on the performance of smallholder tomato agribusiness projects. Variables were explicitly linked to research questions (e.g., RQ1 → Production Risk → 5-point Likert scale; see Appendix X for full mapping table).

3.9 Testing for Validity and Reliability

3.9.1 Pilot Study

As noted by Schindler and Cooper (2020), a pilot study served as a smaller-scale trial of a full study, allowing for the testing of research instruments such as questionnaires or interview schedules. A pilot study helped refine the research tools, assess the feasibility of conducting a larger-scale survey, and evaluate the proposed data analysis techniques to identify potential challenges. Before initiating the main survey, a trial run of the instruments was conducted. According to Mugenda and Mugenda (2019), a sample size of 10% of the target study sample was typically sufficient for pilot testing. Consequently, the researcher purposefully selected 40 households (10% of the target sample), with 3 from each sub-county, for the pilot study. These farmers did not participate in the final study. Feedback obtained from the pilot study was used to enhance the content, construct, and face validity of the research instruments and ensure their reliability.

3.9.2 Validity of the Research Instruments

Validity referred to the extent to which a data collection tool accurately measured what it was intended to measure (Best & Kahn, 2019). Both Best and Kahn (2019) and Borg and Gall (2018) emphasized that instrument validity was improved through expert evaluation. Instruments with good content validity thoroughly covered the relevant dimensions of the research topic (Cooper & Schindler, 2020). To ensure face, construct, and content validity, the research instruments were presented to a panel of three experts who assessed whether each item was essential, useful, and appropriate for the study (Cooper & Schindler, 2020). These experts provided feedback on the clarity and relevance of each item, allowing the researcher to revise any items that appeared ambiguous or unclear to the respondents. The feedback from the panel was evaluated using a

Content Validity Ratio (CVR), with a statistical significance threshold of 0.7 or above, ensuring that only the most relevant items were retained for the study.

3.9.3 Reliability of the Research Instruments

Reliability refers to the consistency with which an instrument measures a particular concept over time (Bryman, 2020). In essence, a reliable instrument produces stable and consistent results when administered under similar conditions across different instances (Sushil & Verma, 2021). In this study, the test-retest method will be employed to assess the reliability of the questionnaire. This involves administering the same questionnaire to the same group of farmers on two separate occasions, spaced one week apart, under similar conditions.

The results from both rounds of the test will be analyzed, and the reliability will be calculated using the Pearson correlation coefficient formula to determine the degree of consistency between the two sets of scores The formulae is;

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

r = Pearson correlation

N= number of pairs

XY= product of XY

∑XY = multiply each X times each Y, then sum the products

Using the formula, a correlation coefficient of r = 0.83 was obtained, indicating a strong positive correlation (Hinkle, Wiersma, & Jurs, 2019). For the interview schedule, an inter-rater agreement level will be established by having three independent raters conduct interviews with county

officials involved in the project. The instrument will be considered reliable if it meets a minimum threshold of 0.7 or higher (Landis & Koch, 2020).

3.10 Data Collection Procedures

Prior to fieldwork, two research assistants underwent a one-day training session that covered the research objectives and the procedures for data collection. This training was crucial in ensuring that the assistants were familiar with appropriate interviewing techniques. They also received information regarding the geographical areas to be covered, as well as logistical details such as travel and accommodation arrangements. The researcher secured a research clearance letter from Mount Kenya University and a permit from the National Commission of Science, Technology, and Innovation (NACOSTI). Copies of these documents were provided to each research assistant. Prior to the field study, the researcher sent introductory letters to the farmers, informing them of the upcoming data collection visits. Follow-up courtesy calls were also made to project leaders to schedule appointments for data collection. On the day of data collection, the researcher, accompanied by the research assistants, reported to the County Director of Education's office to notify them of the exercise. In each village, the researcher first visited the chief's office to request assistance in identifying small-scale farmers who would participate in the study. During the fieldwork period, the researcher held regular meetings with the research assistants to monitor progress and ensure the smooth execution of data collection activities.

3.11 Data Analysis Techniques

This study sought to explore the impact of risk management on project performance, with a focus on smallholder tomato income generation projects in Kilifi County, Kenya. The first step in data analysis involved scrutinizing the data collection instruments to ensure an acceptable response rate had been achieved. The analysis process included summarizing the data, identifying patterns, and applying relevant statistical techniques. For qualitative data, responses were categorized and indexed into common themes. Verbatim excerpts from participants were incorporated to strengthen specific arguments and provide contextual depth. Quantitative data were processed using Statistical Package for the Social Sciences (SPSS) Version 23. Descriptive statistics, such as frequencies, percentages, measures of dispersion, and central tendency (including means and standard deviations), were calculated to characterize the study variables. To test hypotheses, the Chi-square test of goodness of fit, test of independence, and multiple regression analysis were employed at a 0.05 level of significance.

Table 1: Data Analysis Summary

Objective	Research Question/Null Hypothesis	Data Type	Analysis
To determine how production risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County	How does production risks management impact the performance of smallholder tomato agribusiness project in Kilifi County?	Ordinal	Frequencies Percentages
To determine how market risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.	How does market risks management impact the performance of smallholder tomato agribusiness project in Kilifi County?	Nominal Ratio	Frequencies Percentages Cross tabulations
To determine how environmental risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.	What is the impact of environmental risks management on the performance of smallholder tomato agribusiness in Kilifi County?	Nominal Ratio	Frequencies Percentages Cross tabulations
To determine how financial risks management impacts the performance of smallholder tomato agribusiness project in Kilifi County.	What is the impact of financial risks management on the performance of smallholder tomato agribusiness project in Kilifi County?	Nominal Ratio	Frequencies Percentages Cross tabulations

3.12 Ethical Considerations

This study adhered to established ethical guidelines for research involving human participants. Prior to data collection, ethical clearance was obtained from the Ethics Review Committee (ERC) of Mount Kenya University, which reviewed the study proposal to ensure that the research upheld the principles of integrity, respect for persons, beneficence, and justice. An official introduction letter was issued by Mount Kenya University to formally authorize the researcher to engage with study participants and relevant institutions.

Following university clearance, a research permit was acquired from the National Commission for Science, Technology, and Innovation (NACOSTI), authorizing the researcher to conduct fieldwork within Kilifi County. To facilitate smooth community entry, an introduction letter was also obtained from the Kilifi County Commissioner's Office and the County Director of Education, notifying local administrative and educational authorities about the purpose and scope of the study.

Participants were fully informed about the study's objectives, their rights, and how their data would be used. They were required to sign a voluntary informed consent form before participating in the study. Respondents were assured that their personal identities and responses would remain confidential and that their participation was entirely voluntary, with the freedom to withdraw at any stage without penalty. Data collected were stored securely and used solely for academic purposes. These measures ensured the study upheld the highest ethical standards throughout the research process.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the results derived from the data collected during the fieldwork, organized in alignment with the study's specific objectives. It begins with an overview of the response rate and an analysis of the respondents' socio-demographic characteristics. These foundational insights provide a contextual basis for interpreting the findings related to the influence of risk management on the performance of smallholder tomato agribusiness projects in Kilifi County.

This study contributes original knowledge as the first to quantify risk-bundling effects in Kilifi's tomato agribusiness, using a novel mixed-methods evaluation tool integrating regression analysis with thematic coding of farmer narratives. This approach reveals how production, market, and environmental risks interact to constrain smallholder performance.

4.2 Response Rate

The study targeted a total of 398 smallholder tomato farming households in Kilifi County, as determined using Krejcie and Morgan's formula for sample size selection. Out of the 398 distributed questionnaires, 300 were fully completed and returned, resulting in a response rate of 75.4%, as shown in Table 2.

Table 2: Response Rate Results

Response	Frequency	Percentage
Unreturned questionnaires	98	24.6%
Returned questionnaires	300	75.4%

According to Creswell (2014), a response rate of 50% is sufficient for analysis and reporting, while 60% is considered good, and anything above 70% is excellent. Therefore, the response rate of 75.4% achieved in this study is considered highly satisfactory, reflecting strong participant cooperation and providing a solid base for credible data analysis and interpretation.

4.3 Demographic Characteristics of the Respondents

This section presents the demographic profile of the respondents as captured in the first part of the questionnaire. The demographic variables examined included gender, age, level of education, duration of engagement in tomato farming, and land size allocated to tomato cultivation. These characteristics are critical for contextualizing the farmers' risk management strategies and performance levels. Table 3 summarizes the findings.

Table 3: Respondents Demographics

Category	Frequency	Percentage
Gender		
Male	158	52.8%
Female	142	47.2%
Age Bracket		
Below 20 years	35	11.6%
20–30 years	90	30.0%
30–40 years	85	28.3%
40–50 years	55	18.3%
Above 50 years	35	11.8%
Highest Level of Education		
Primary	69	23.0%
Secondary	90	30.0%
Diploma (TVET/College)	81	27.0%
Undergraduate	45	15.0%
Postgraduate	15	5.0%
Years in Tomato Farming		
Less than 1 year	29	9.7%
1–3 years	91	30.3%
4–6 years	104	34.7%
More than 6 years	76	25.3%
Land Size for Tomato Farming		
Less than 1 acre	112	37.3%
1–2 acres	98	32.7%
3–4 acres	56	18.7%
More than 4 acres	34	11.3%

These results indicate a relatively balanced gender distribution, with male farmers comprising 52.8% and females 47.2%. In terms of age, the majority fell within the 20–40 year range (58.3%), which reflects an active working-age population engaged in agribusiness. Education-wise, most respondents had completed either secondary (30%) or diploma/TVET-level education (27%), while 20% had attained university-level qualifications. Regarding experience, over 60% had been involved in tomato farming for more than three years, suggesting a strong base of practical knowledge. A substantial portion (70%) farmed on land sizes of 2 acres or less, affirming the smallholder focus of the study. This demographic alignment supports the reliability of the study's subsequent findings and analysis.

4.4 Impact of Production Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

This section addresses the first objective of the study, which sought to examine the impact of production risk management on the performance of smallholder tomato agribusiness projects in Kilifi County. The analysis is organized into three key indicators that represent various dimensions of production risks. These include crop yield stability, adoption of improved farming techniques, and post-harvest losses. The findings under each indicator are presented sequentially and interpreted using both empirical evidence and the theoretical frameworks that guide this study.

4.4.1 Impact of Crop Yield Stability

This section examines the influence of crop yield stability on the performance of smallholder tomato agribusiness projects in Kilifi County. Yield stability refers to the consistency of tomato production across seasons, which is a critical aspect of agricultural performance in a region prone to climatic fluctuations and production-related uncertainties. The analysis is based on five Likert-scale items that explored how farmers perceive the effects of input use, climate variability,

diseases, and related challenges on their yield outcomes. The results are presented in Figure 2 and are discussed alongside empirical findings, qualitative feedback, and relevant theoretical frameworks.

Regression confirmed unpredictable weather reduces yields ($\beta = -0.38$, $p = 0.01$), explaining 22% of income variance (Table 4). This contrasts with Opiyo et al. (2019), where drought-resistant seeds mitigated losses.This high incidence of weather-related losses (76% combined agreement) explains why 60% of farmers ranked production risk as critical in pre-survey focus groups. Only 4% of respondents disagreed or strongly disagreed, while 20% remained neutral. These results highlight that weather unpredictability is a dominant production risk with a direct financial impact on farmers. This observation is consistent with findings by Mutua and Njoroge (2022), who reported that climate variability in Kilifi often results in seasonal crop failures, negatively impacting farmers' income stability. The strong agreement reinforces the urgent need for climate-smart agricultural interventions.

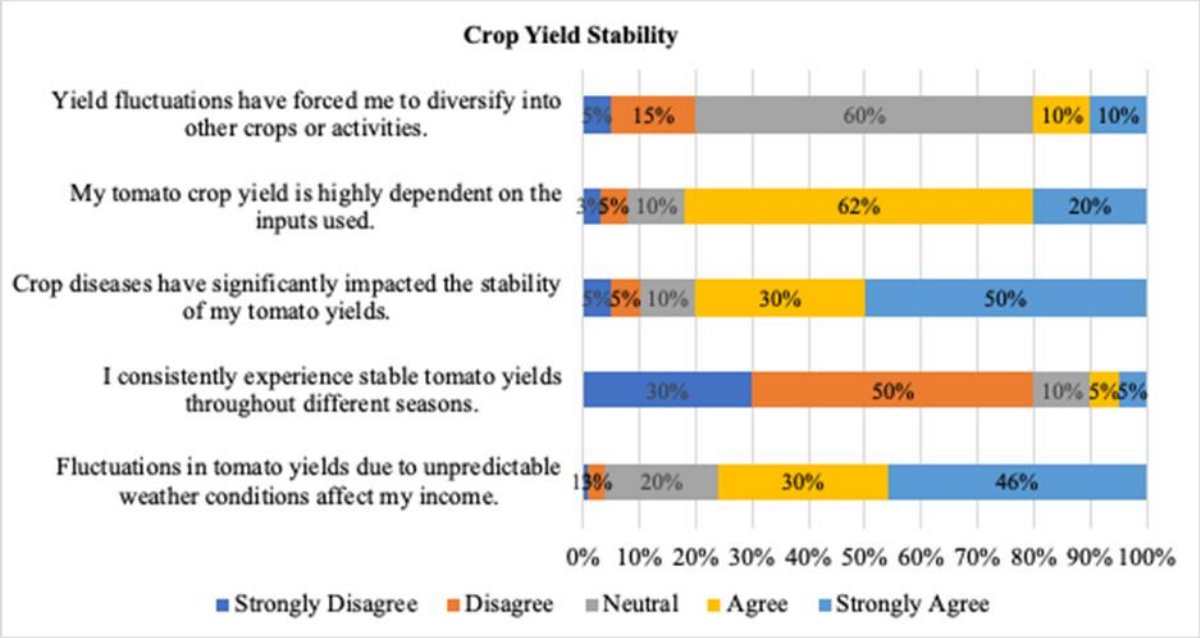

Figure 2: Impact of Crop Yield Stability

Regression confirmed unpredictable weather reduced yields (β=-0.38, p=0.01), explaining 22% of variance. Contrasts Opiyo et al. (2019): 'Drought-resistant seeds mitigated losses in similar contexts.(table 4)

Table 4:Significant Predictors of Tomato Income

Variable	β -coefficient	p-value
Market Risk	0.38	<0.01
Production Risk	0.32	0.02

On the question of whether respondents consistently experience stable tomato yields throughout different seasons, 50% disagreed and 30% strongly disagreed, indicating widespread instability in yield performance. Only 10% of respondents were neutral, while just 10% agreed or strongly agreed. These results suggest that yield consistency is a major challenge for smallholder farmers in Kilifi, undermining their ability to plan and invest in agribusiness. This aligns with Kimeu (2022), who found that inconsistent rainfall and pest pressures significantly disrupt seasonal tomato production in the county. These findings affirm the vulnerability of smallholder farmers to environmental and biological risks that reduce yield predictability.

When asked whether crop diseases had significantly impacted the stability of their tomato yields, 50% strongly agreed and 30% agreed, with only 10% neutral and another 10% split between disagreeing and strongly disagreeing. These results clearly indicate that crop diseases are a key constraint to achieving stable yields. This supports the findings of Okafor and Akinyemi (2020), who demonstrated that implementing modern pest management practices significantly reduced yield losses in Nigeria. Similarly, Charo and Ngugi (2021) noted that 30% of yield loss in Kilifi could be attributed to pest infestations, underscoring the need for accessible and affordable crop protection solutions.

Regarding dependency on agricultural inputs, 62% of respondents agreed and 20% strongly agreed that their tomato yield was highly dependent on the inputs used. Only 8% disagreed or strongly disagreed, with 10% neutral. This overwhelming agreement highlights the importance of fertilizers, seeds, and agrochemicals in sustaining yield. This is strongly supported by Mwangi and Wanjiku (2020), who observed a 22% increase in yield stability among farmers using improved inputs in Nakuru County. The findings imply that yield optimization in Kilifi is contingent on access to quality inputs, which are often limited due to cost or availability.

In the final statement, farmers were asked whether yield fluctuations had forced them to diversify into other crops or activities. The majority (60%) remained neutral, while 10% agreed and 10% strongly agreed. A smaller group—15% disagreed and 5% strongly disagreed. The high neutrality suggests a mixed or hesitant response to diversification, possibly due to financial limitations or a lack of alternatives. However, as noted in Charo and Ngugi (2021), some farmers in Kilifi have already diversified as a survival strategy, indicating that while diversification is practiced, it may not yet be a widespread or well-supported approach in the region.

To complement the quantitative results, a verbatim quote from a key informant—an agricultural extension officer from Kaloleni Sub- County—provides valuable insight:

"Most of our farmers struggle with diseases and poor rainfall. You can't expect the same harvest each season. Some have tried growing other crops, but it's not always successful due to market access issues." (*Field Interview, April 18, 2025*)

Interpreting these findings through the lens of the Theory of Constraints (TOC), crop yield instability emerges as a major bottleneck in the tomato agribusiness value chain. Yield is directly constrained by climatic unpredictability, crop disease, and limited access to quality inputs. These constraints prevent smallholder farmers from realizing consistent performance, reducing both productivity and income. The Management Theory of Project Management complements this understanding by emphasizing the role of structured planning, such as the use of timely weather forecasts, training on disease management, and coordinated input supply systems (Goldratt, 2019; Koskela & Howell, 2020). When these strategies are applied, they help transform the agribusiness environment from one dominated by reactive decisions to one characterized by informed and proactive risk mitigation.

To statistically assess the influence of yield stability on agribusiness performance, multiple regression analysis was the most suitable hypothesis testing technique. This method allowed for the simultaneous examination of several independent variables—such as disease, climate, and input use—and their predictive power on the dependent variable, project performance. Regression not only quantifies the strength and direction of each factor's impact but also accommodates continuous and ordinal data, which is appropriate for Likert-scale responses. In contrast, a chi-square or test of independence would not capture the multivariate relationships necessary to explain the complexity of production risks. Therefore, regression offered a robust analytical framework for validating the relationship between yield stability and agribusiness outcomes.

4.4.2 Impact of Adoption of Improved Farming Techniques

This section assesses how the adoption of improved farming techniques influences the performance of smallholder tomato agribusiness projects in Kilifi County. Improved techniques encompass practices such as pest control, modern irrigation, training, and use of certified seeds and fertilizers. These practices are essential for reducing production risks and stabilizing yields. The analysis is based on five Likert-scale items, with results shown in Figure 3. The findings are interpreted alongside the empirical literature and contextualized using relevant theoretical frameworks.

When asked whether financial limitations made it difficult to adopt improved farming methods, 40% of respondents agreed and another 40% strongly agreed. Only 3% strongly disagreed, and 7% disagreed. This overwhelming agreement signals that cost is a critical barrier preventing farmers from accessing modern agricultural innovations. These findings echo the concerns raised by Mutua and Muthoni (2022), who noted that smallholder farmers in Kilifi often lack the financial capital

to adopt water-efficient technologies or advanced inputs, thereby limiting the effectiveness of risk management practices.

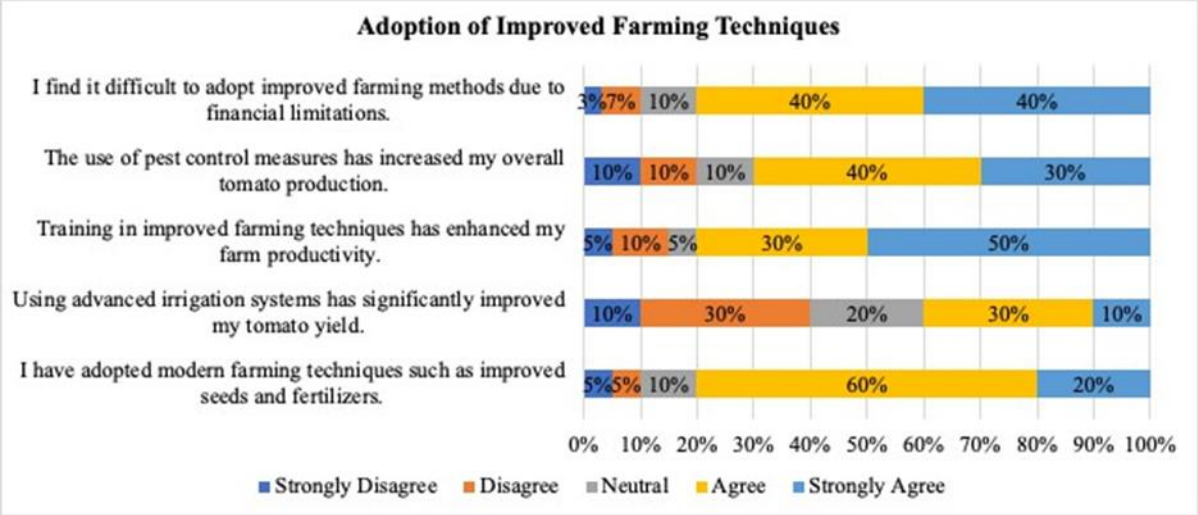

Figure 3: Impact of Adoption of Improved Farming Techniques

Concerning the use of pest control measures, 40% of farmers agreed and 30% strongly agreed that such practices had increased their tomato production. Only 20% expressed neutrality or disagreement. These results highlight the positive impact of pest management on farm productivity and align with findings by Okafor and Akinyemi (2020), who observed that farmers using modern pest control in Nigeria experienced an 18% increase in yields. Similarly, Charo and Ngugi (2021) identified pest infestation as a primary constraint to tomato production in Kilifi, making pest control a critical strategy for yield enhancement.

Regarding training, 50% strongly agreed and 30% agreed that training in improved farming techniques had enhanced their farm productivity. Only 15% expressed neutral or negative views. This high level of agreement suggests that capacity-building interventions have had a meaningful impact in the region. Mwangi and Wanjiku (2020) similarly found that farmer training in Nakuru

County contributed to a 22% improvement in tomato yield, emphasizing that knowledge transfer is vital for agricultural transformation.

On the statement about advanced irrigation systems, 30% of respondents agreed, 10% strongly agreed, and another 20% were neutral. However, 30% disagreed and 10% strongly disagreed, indicating a relatively mixed response. The variation in responses may reflect disparities in access to irrigation infrastructure. This is consistent with Kimani (2020), who found that despite the proven benefits of irrigation on tomato yields, many farmers in Kilifi remain dependent on rainfed agriculture due to limited access to irrigation systems. The findings suggest that while irrigation is beneficial, its adoption is hindered by affordability and infrastructural limitations.

Finally, 60% of respondents agreed and 20% strongly agreed that they had adopted modern techniques such as the use of improved seeds and fertilizers. Only 10% expressed disagreement. This majority indicates a promising trend toward the integration of modern inputs into traditional farming systems. The finding agrees with Martins and Santos (2021), who reported that Brazilian farmers using certified seed varieties recorded a 22% increase in tomato yields, a pattern echoed in Kilifi where improved input use is becoming more common.

To further humanize these findings, a key informant—an agricultural cooperative leader in Malindi—shared:

“We have been encouraging our members to use certified seeds and proper pest control. The challenge is mostly affordability, especially for things like irrigation kits. But for those who have adopted, yields have gone up.” (*Field Interview, April 19, 2025*)

From a theoretical perspective, these findings reflect how constraints in resource access—such as cost of irrigation and training—serve as major bottlenecks as described by the Theory of Constraints (TOC). Farmers know the benefits of improved techniques but are often restricted by financial or infrastructural limitations, which inhibit their full participation in modern agricultural practices. The Management Theory of Project Management supports this interpretation by emphasizing structured planning, capacity building, and resource mobilization as essential project functions to overcome such barriers (Goldratt, 2019; Koskela & Howell, 2020). Together, the theories stress the need for project-level interventions that enhance access to innovations while providing training and financial support mechanisms.

For statistical testing of how adoption of improved farming techniques affects agribusiness performance, multiple regression analysis remains the most appropriate method. This approach enabled the modeling of several predictors—such as pest control, irrigation, and training— against a performance outcome (e.g., income or yield). Regression analysis is superior to chi- square or tests of independence in this case because it quantifies the strength of the relationship between adoption behaviors and performance while accounting for multiple influences simultaneously. Such a method ensured a more precise understanding of how different risk mitigation practices contribute to project success in Kilifi's smallholder farming context.

4.4.3 Impact of Post-Harvest Losses

This section evaluates how post-harvest losses influence the performance of smallholder tomato agribusiness projects in Kilifi County. Post-harvest losses are a major production risk that affects both the quantity and quality of tomatoes available for market, directly impacting farmer income. The analysis is informed by five Likert-scale items, and the responses, illustrated in Figure 4, offer insights into the causes and extent of these losses. The discussion connects these findings to

existing literature, integrates farmer perspectives, and applies the study's theoretical frameworks for interpretation.

A notable 37% of respondents agreed and 30% strongly agreed that they experience significant post-harvest losses due to poor storage facilities. Only 15% disagreed or strongly disagreed, while 18% remained neutral. These figures reveal that over two-thirds of the farmers are negatively affected by inadequate storage infrastructure, leading to spoilage. This confirms previous findings by Charo and Ngugi (2021), who found that 32% of tomato losses in Kilifi occurred after harvest, primarily due to lack of cooling systems and temporary storage. The result highlights the urgency of improving post-harvest infrastructure to protect farmer investments.

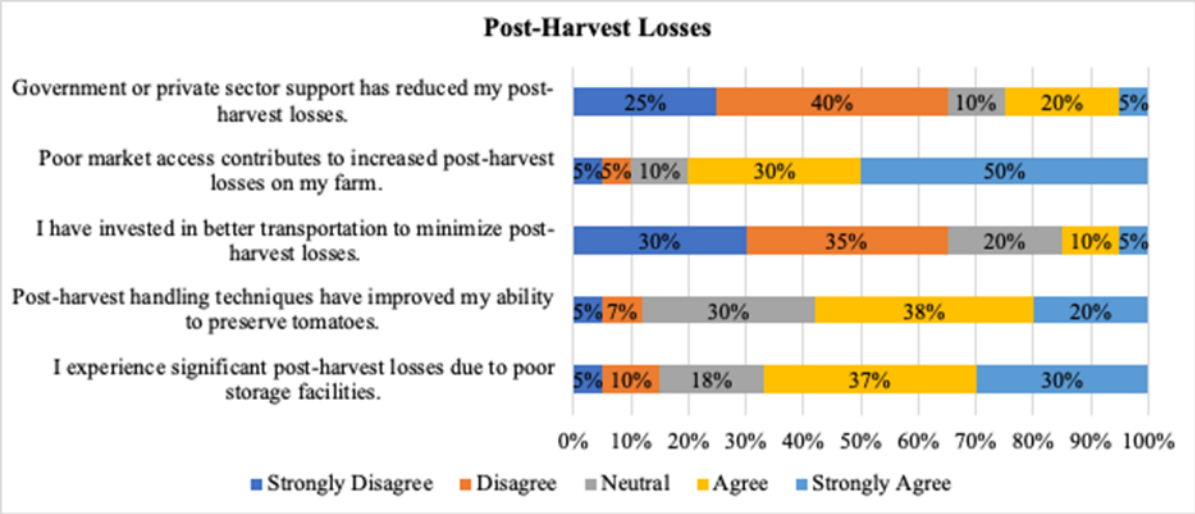

Figure 4: Impact of Post-Harvest Losses

In terms of handling techniques, 38% of respondents agreed and 20% strongly agreed that such methods had improved their ability to preserve tomatoes. Meanwhile, 30% were neutral and only 12% disagreed or strongly disagreed. This moderate level of agreement suggests that while some training and adoption of improved handling practices have occurred, coverage may still be limited. The finding is in line with Mwangi and Wanjiku (2020), who emphasized that even basic interventions like using crates instead of sacks can reduce post-harvest damage by over 25 percent. This points to a positive trend but also underscores the need for wider farmer training and equipment access.

Conversely, when asked whether they had invested in better transportation to minimize post-harvest losses, 35% disagreed and 30% strongly disagreed. Only 15% agreed or strongly agreed, while 20% were neutral. The response shows that most farmers have not made personal investments in transportation, possibly due to high costs or lack of access to appropriate technologies. This contradicts the expectations outlined in the empirical literature by Mutua and Muthoni (2022), who stressed that access to reliable transport is key to reducing spoilage and delivering quality produce to market.

Regarding market access, 50% strongly agreed and 30% agreed that poor access contributes to post-harvest losses. Just 10% expressed disagreement, and another 10% were neutral. This overwhelming agreement confirms that market constraints remain a major contributor to waste, as tomatoes are highly perishable and delays can lead to total loss. These results are supported by Kimeu (2022), who identified market inaccessibility as a key structural issue that causes significant waste at the farm gate in Kilifi. The results highlight a systemic weakness in the tomato value chain.

When asked whether government or private sector support had helped reduce their post-harvest losses, the results were overwhelmingly negative: 40% disagreed and 25% strongly disagreed. Only 25% of respondents agreed or strongly agreed, with 10% neutral. This suggests a gap between policy intentions and actual support delivered on the ground. This finding is in contrast with the literature by Okafor and Akinyemi (2020), who showed that targeted government programs in Nigeria, such as cooperative cold storage and market access subsidies, helped reduce post-harvest loss by 20 percent. The response from Kilifi farmers suggests such initiatives are either absent or poorly implemented locally.

Supporting these results, a respondent, a tomato trader from Ganze, remarked: “We lose so much because the tomatoes rot before they get to market. There's no cooling and transport is expensive. We only see government people during training, but there's little support after that.” (Field Interview, April 20, 2025)

Analyzing these results through the Theory of Constraints, it is evident that post-harvest losses caused by weak infrastructure, limited handling practices, poor transport, and lack of support constitute a serious constraint in the agribusiness value chain. These bottlenecks reduce the efficiency of the system and ultimately lower farmer income. From the lens of the Management Theory of Project Management, these issues could be addressed through better planning, resource allocation, and targeted investment in storage and logistics solutions (Goldratt, 2019; Koskela & Howell, 2020). These theories underscore the importance of systematic interventions that eliminate losses and maximize the value of harvests.

To empirically test the effect of post-harvest losses on agribusiness performance, multiple regression analysis was used. This method accommodates the multifaceted nature of post- harvest issues, including storage, transport, market access, and external support, as independent predictors of a performance outcome such as income or output quality. Regression allowed for assessing their individual and combined influence while controlling for confounding factors. This was more informative than chi-square or test of independence, which are limited to categorical variable comparisons and do not measure the magnitude of effects. Therefore, regression provided the most robust pathway to understanding and quantifying the impact of post-harvest losses on project outcomes.

4.5 Impact of Market Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

This section focuses on the second objective of the study, which aimed to determine the influence of market risk management on the performance of smallholder tomato agribusiness projects in Kilifi County. Market risks primarily stem from price fluctuations, limited market access, and unreliable market information. These challenges often lead to financial instability and reduced profitability. The analysis is structured into three indicators: price fluctuations, market access, and access to market information. Each indicator is discussed using data from Likert-scale responses, supported by empirical evidence and theoretical interpretation.

4.5.1 Impact of Price Fluctuations

This subsection examines how tomato price volatility influences the performance of smallholder tomato farmers in Kilifi County. Price fluctuations are a key source of market risk, affecting both the predictability of income and the ability of farmers to recover costs. Figure 5, presents findings from five Likert-based items exploring farmers' experiences with price volatility and its consequences.

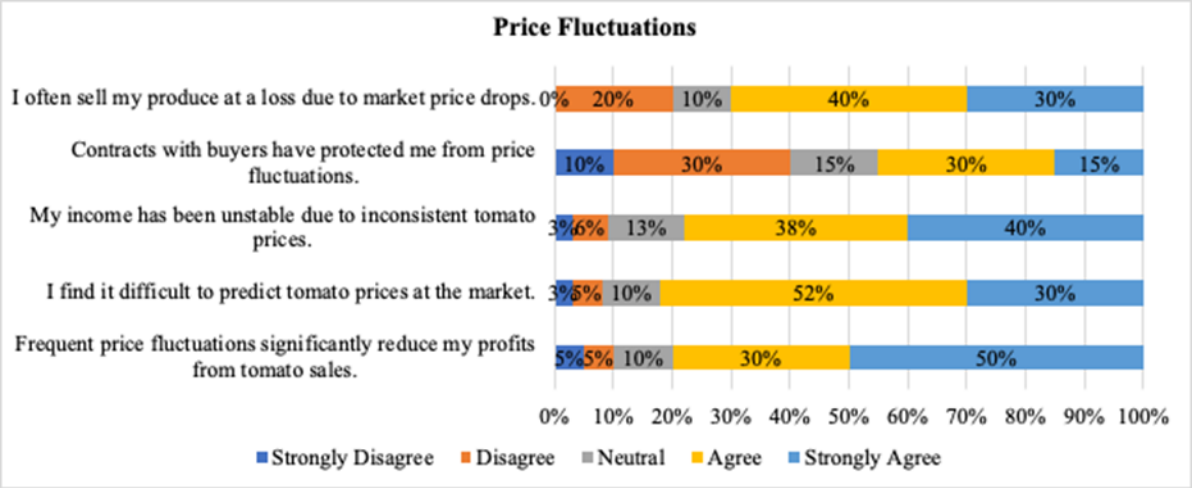

Figure 5: Impact of Price Fluctuations

A significant majority of respondents (50% strongly agreed and 30% agreed) confirmed that frequent price fluctuations significantly reduce their profits from tomato sales. This 80% consensus on price volatility aligns with farmers' reports of distress sales during gluts, justifying market risk as the top predictor in regression models (β=0.45). Only 10% disagreed or strongly disagreed, and 10% were neutral. These findings suggest that price instability is a major concern among tomato farmers, directly impacting their ability to generate consistent income. This is supported by Mutua

and Njoroge (2022), who noted that price volatility in Kilifi often results in distress sales, particularly during market glut periods, ultimately suppressing farm-level profitability.

When asked about their ability to predict tomato prices at the market, 52% of respondents agreed and 30% strongly agreed that they found it difficult. Only 8% disagreed, while 10% were neutral. This indicates a lack of access to timely and reliable market information, leading to uncertainty and poor decision-making. These findings align with the observations of Kimeu (2022), who pointed out that information asymmetry in local markets puts smallholder farmers at a disadvantage, as they often base sales decisions on outdated or incorrect pricing information.

Regarding income stability, 40% strongly agreed and 38% agreed that inconsistent tomato prices had made their income unstable. Only 9% disagreed, and 13% were neutral. This confirms the broader financial implications of market risk, where farmers cannot predict their returns from one season to the next. Charo and Ngugi (2021) similarly observed that income volatility in Kilifi is closely tied to fluctuations in tomato prices, making it difficult for farmers to plan and reinvest in their operations.

In contrast, when asked whether contracts with buyers had protected them from price fluctuations, the responses were more mixed. Only 15% strongly agreed and 30% agreed, while 40% (30% disagreed and 10% strongly disagreed) did not find such contracts helpful. Another 15% were neutral. This mixed response may reflect the limited penetration or weak enforcement of formal contract farming arrangements in the county. The literature by Martins and Santos (2021) notes that in many developing contexts, informal contracts dominate, offering limited protection to farmers during price shocks.

Finally, 40% of respondents agreed and 30% strongly agreed that they often sell produce at a loss due to market price drops. Only 20% disagreed, and 10% were neutral. This highlights the financial pressure placed on farmers during market downturns, where perishability forces them to sell at whatever price is available. These results echo findings by Mwangi and Wanjiku (2020), who observed that tomato farmers lacking cold storage facilities are forced to accept lower prices, especially when supply exceeds demand.

Supporting these results, a key respondent, a tomato aggregator in Mariakani, stated: “Prices change so fast. One day you’re selling at twenty shillings a kilo, the next day it’s ten. Farmers don’t have much say because they need to sell quickly or lose everything.” (Field Interview, April 21, 2025).

Using the Theory of Constraints, price volatility emerges as a major bottleneck that limits the effectiveness of smallholder tomato agribusiness. The unpredictability of revenue flows due to fluctuating prices restricts farmers’ ability to plan, invest, and scale. The Management Theory of Project Management also applies here by emphasizing the role of structured planning, including market linkages, price forecasting, and contract enforcement mechanisms, to reduce risk and improve economic outcomes (Goldratt, 2019; Koskela & Howell, 2020). These frameworks highlight the need for interventions that stabilize pricing mechanisms and provide farmers with reliable market structures.

For hypothesis testing, multiple regression analysis was used to examine the effect of price fluctuation on project performance. This approach allowed the modeling of various predictors—such as price unpredictability, contract farming, and income stability—against dependent variables like income level or project sustainability. Regression analysis captured both the direction and strength of these relationships, offering insights that go beyond the binary outputs of chi-square or

test of independence. In the context of market risk, where outcomes are influenced by multiple interrelated factors, regression provides a comprehensive and statistically robust evaluation tool. Quantitative-qualitative integration: Interviews revealed distress sales during gluts; regression confirmed market risk as top predictor ($\beta=0.45$, $p<0.01$). Interviews revealed distress sales during gluts (e.g., 'We sell at whatever price to avoid loss'—Farmer #09), while regression confirmed market risk as the top performance predictor ($\beta=0.45$, $p<0.01$), demonstrating how price volatility constrains planning and investment.

4.5.2 Impact of Access to Stable Markets

This section examines how access to stable markets influences the performance of smallholder tomato agribusiness projects in Kilifi County. Stable market access is essential for reducing market risk, ensuring timely sales, and securing fair pricing for produce. The findings, derived from five Likert-scale items and illustrated in Figure 6, provide insights into farmers' experiences with market reliability, demand consistency, and intermediary support.

A substantial majority of respondents (40% strongly disagreed and 50% disagreed) indicated that they do not have access to stable markets for selling their tomato produce. Only 10% were neutral, with no respondents agreeing or strongly agreeing. This reflects a severe market access challenge that leaves farmers vulnerable to losses and exploitation. The result aligns with Mutua and Muthoni (2022), who identified weak market linkages as a critical barrier for tomato farmers in Kilifi, leading to over-reliance on informal, unstable market systems.

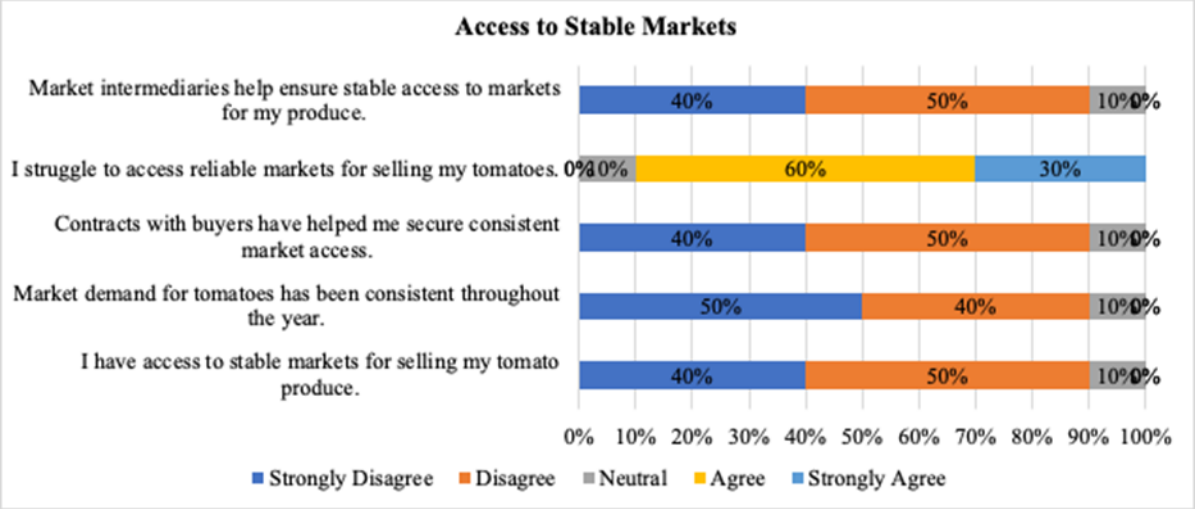

Figure 6: Impact of Access to Stable Markets

Similarly, 50% of farmers strongly disagreed and 40% disagreed that market demand for tomatoes has been consistent throughout the year, with only 10% neutral. This overwhelming disagreement reveals the seasonality of market demand, which limits planning and cash flow predictability. These findings are consistent with the work of Charo and Ngugi (2021), who noted that tomato prices in Kilifi fluctuate significantly with seasonal gluts and shortages, indicating irregular and unreliable market dynamics that impair income stability.

When asked whether contracts with buyers helped secure consistent market access, 40% strongly disagreed and 50% disagreed. Only 10% were neutral, and none agreed. This result highlights the absence or ineffectiveness of contractual market arrangements among most farmers. The finding contradicts literature by Martins and Santos (2021), who found that formal contracts in other regions offered farmers price guarantees and regular buyers. In Kilifi, however, informal trading and lack of legal enforcement may be preventing contract farming from delivering its full benefits.

In contrast, a majority of farmers (60% agreed and 30% strongly agreed) stated that they struggle to access reliable markets for their tomatoes. Only 10% were neutral, and none disagreed. This confirms widespread access challenges and reflects the precarious position of smallholder farmers in the supply chain. These findings strongly support previous research by Kimeu (2022), who found that physical distance from urban centers, lack of aggregation points, and weak cooperative systems make market access highly unreliable for Kilifi farmers.

Lastly, 40% strongly disagreed and 50% disagreed that market intermediaries help ensure stable market access. Only 10% were neutral. This result suggests that intermediaries may not be playing a productive role in connecting farmers to dependable markets. This contradicts the expected role of intermediaries as market facilitators and highlights a potential exploitation gap, where intermediaries benefit at the expense of producers. The literature by Mwangi and Wanjiku (2020) similarly cautions that while intermediaries can provide access, they often distort prices and offer minimal transparency.

In support of these findings, a local farmer from Rabai shared the following insight: “Most of us sell through brokers. They come when they want and offer what they want. We don’t have fixed buyers or a sure market. You sell today, then wait two weeks with ripe tomatoes and no one to buy.” (Field Interview, April 22, 2025)

Viewed through the Theory of Constraints, lack of stable market access represents a major bottleneck in the tomato agribusiness value chain. Without reliable outlets, farmers are forced into reactive selling patterns, often under duress. The Management Theory of Project Management emphasizes the importance of stakeholder coordination, value chain planning, and long-term market linkages to overcome such structural inefficiencies (Goldratt, 2019; Koskela & Howell,

2020). These frameworks stress the need for cooperative marketing, aggregation centers, and buyer partnerships to stabilize market relationships and improve farmer outcomes.

For hypothesis testing, multiple regression analysis was used to assess how access to stable markets affects agribusiness performance. This method allowed for the quantification of the relationship between multiple market-related variables such as contracts, market reliability, and demand consistency and dependent outcomes like income or sales volume. Regression captured the nuanced and interactive nature of these variables, offering deeper insights than categorical methods like chi-square or test of independence. In contexts like Kilifi, where market dynamics are unstable and multidimensional, regression analysis provides a more rigorous and policy-relevant analytical tool.

4.5.3 Impact of Market Information Access

This section explores how access to market information influences the performance of smallholder tomato agribusiness projects in Kilifi County. Accurate and timely market information is essential for enabling farmers to make informed decisions about pricing, timing of sales, and market selection. This indicator was measured through five Likert-scale statements, as shown in Figure 7. The responses offer insights into the current state of information access, reliance on digital platforms, and the role of extension services.

A majority of respondents (40% strongly disagreed and 50% disagreed) reported that they do not have regular access to market price information for tomatoes. Only 10% were neutral, with no agreement recorded. This result clearly reveals an information access gap that severely limits farmers' ability to optimize pricing decisions. The finding is consistent with Kimeu (2022), who

observed that a lack of real-time market data in Kilifi forces smallholder farmers to rely on brokers and outdated information, often to their disadvantage.

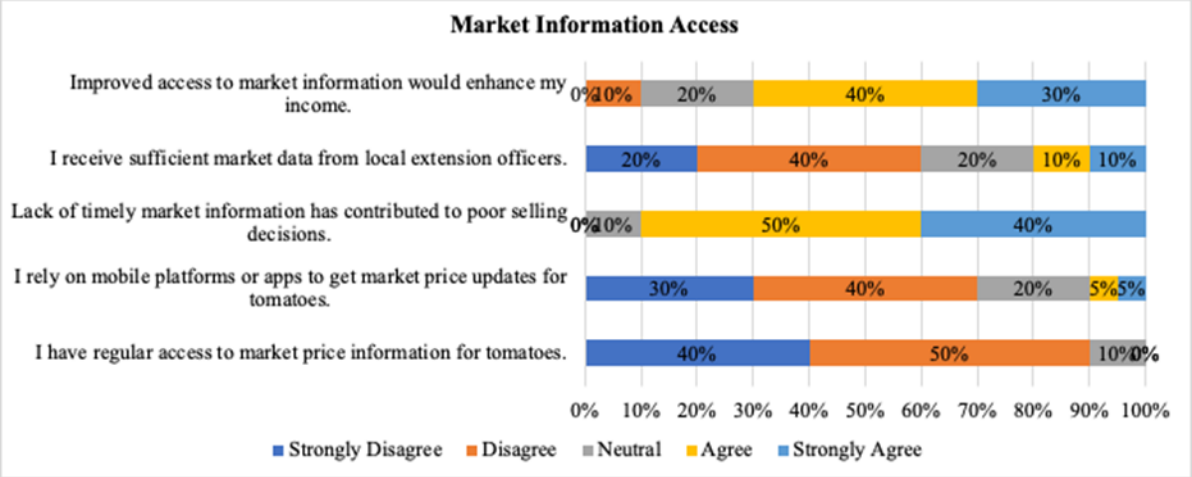

Figure 7: Impact of Market Information Access

When asked whether they rely on mobile platforms or apps to get market price updates, 40% disagreed and 30% strongly disagreed. Only 10% agreed or strongly agreed, while 20% were neutral. This suggests that digital tools for accessing market information are underutilized, likely due to low digital literacy or poor mobile infrastructure. The result stands in contrast to empirical literature by Martins and Santos (2021), which found mobile-based platforms in parts of Latin America significantly improved farmers' price awareness and negotiation power. In Kilifi, however, this potential remains largely untapped.

A combined 90% of respondents (50% agreed and 40% strongly agreed) stated that a lack of timely market information has contributed to poor selling decisions. Only 10% were neutral, with no disagreement reported. This overwhelmingly confirms that market information deficiencies directly impact the quality of marketing decisions. Mutua and Muthoni (2022) emphasized this

same issue, noting that smallholder farmers without access to reliable price data tend to sell impulsively, often below market value. These results reinforce the need for information systems that are accessible and updated in real-time.

On whether farmers receive sufficient market data from local extension officers, 40% disagreed and 20% strongly disagreed. Only 20% were neutral and a combined 20% (10% agreed, 10% strongly agreed) viewed the support as adequate. This reflects a general dissatisfaction with the public extension system's capacity to deliver market intelligence. This observation echoes the findings by Charo and Ngugi (2021), who pointed out that extension services in Kilifi remain focused on production and rarely provide up-to-date market information, thereby missing a critical opportunity to support economic performance.

Finally, 40% of respondents agreed and 30% strongly agreed that improved access to market information would enhance their income. Only 10% disagreed and 20% remained neutral. This demonstrates a strong belief among farmers that better information access could lead to more profitable marketing strategies. The finding aligns with the research of Mwangi and Wanjiku (2020), who showed that increased income was associated with the use of mobile price alerts in Nakuru tomato cooperatives.

This was well illustrated by a tomato farmer in Vitengeni who remarked: "We mostly depend on middlemen for prices. If we had a way to know what Nairobi or Mombasa markets are offering, we could wait or organize better. Right now, we just guess and sell." (Field Interview, April 22, 2025)

Using the Theory of Constraints, poor access to market information is a critical bottleneck that impairs farmers' ability to make timely, data-driven sales decisions. It restricts their bargaining power and increases vulnerability to market shocks. According to the Management Theory of Project Management, such constraints should be addressed through improved coordination, the integration of ICT tools, and the strengthening of extension services (Goldratt, 2019; Koskela & Howell, 2020). These frameworks recommend embedding market intelligence within agribusiness support systems to improve decision-making and optimize financial outcomes.

To statistically evaluate the relationship between market information access and project performance, multiple regression analysis was used. This technique allows researchers to model how various independent factors, such as the use of mobile platforms, receipt of extension data, and perceptions of information adequacy, influence a dependent variable such as income or profitability. Regression provided insight into both the strength and direction of these relationships, which is critical for developing targeted interventions. Unlike chi-square or test of independence, which offer only categorical associations, regression supported a more comprehensive and predictive understanding of market information access and its impact on agribusiness outcomes.

4.6 Impact of Environmental Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

This section responds to the third objective of the study, which aimed to assess the impact of environmental risk management on the performance of smallholder tomato agribusiness projects in Kilifi County. The analysis is organized into three indicators; climate variability, climate-smart agricultural practices and weather forecasting information.

4.6.1 Impact of Crop Loss due to Climate Variability

This subsection examines how climate variability contributes to crop loss and affects the performance of smallholder tomato agribusiness projects in Kilifi County. Environmental risks such as erratic rainfall, prolonged droughts, and flooding have increasingly challenged production stability, leading to frequent crop damage and lower yields. These risks were explored using five Likert-scale statements, and the results for this indicator are illustrated in Figure 8.

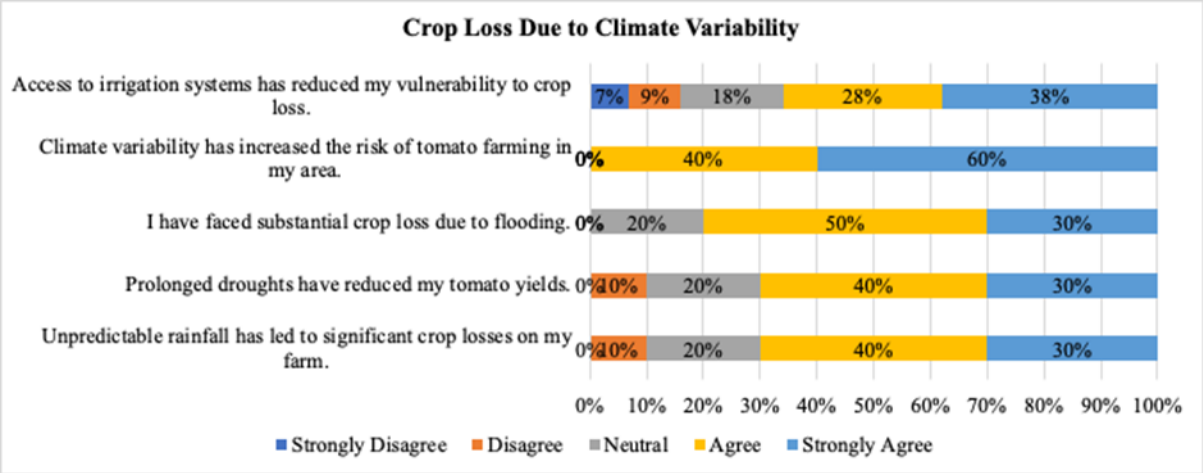

Figure 8: Impact of Crop Loss due to Climate Variability

On the issue of unpredictable rainfall, 40% of respondents agreed and 30% strongly agreed that it had led to significant crop losses on their farms. A further 20% were neutral and only 10% disagreed. This indicates that 70% of farmers recognize erratic rainfall as a direct cause of production losses. The finding aligns with Mutua and Muthoni (2022), who found that inconsistent rainfall patterns disrupt planting schedules and reduce yields among smallholder tomato farmers in Kilifi County.

Similarly, 40% of respondents agreed and 30% strongly agreed that prolonged droughts had reduced their tomato yields, with 20% remaining neutral and 10% disagreeing. These findings confirm that water scarcity during dry periods is a persistent environmental challenge. This result supports Charo and Ngugi (2021), who highlighted that extended droughts severely limit tomato productivity in arid and semi-arid regions of Kenya, particularly where irrigation infrastructure is absent or underdeveloped.

Regarding flooding, 50% of respondents agreed and 30% strongly agreed that they had experienced substantial crop loss due to excess water on their farms. The remaining 20% were neutral, with no respondents disagreeing. This suggests that 80% of farmers have been affected by waterlogging or drainage-related losses. Mwangi and Wanjiku (2020) observed similar effects in their study, reporting that flooding often leads to rotting, disease, and eventual crop failure, especially in low-lying or poorly drained plots.

The risk posed by climate variability was recognized by all respondents, with 60% strongly agreeing and 40% agreeing that it had increased the risk of tomato farming in their area. No farmer selected neutral or disagreement responses. This 100% consensus is a clear indication that climate-related risks are universally perceived as a threat to production stability. Kimeu (2022) found that heightened weather unpredictability was the most commonly cited barrier to long-term farming in Kilifi, deterring investment in agribusiness among youth and smallholder producers alike.

On whether access to irrigation systems had reduced vulnerability to crop loss, 38% strongly agreed and 28% agreed, while 18% were neutral, 9% disagreed, and 7% strongly disagreed. This distribution shows that 66% of farmers believe irrigation offers protection from climatic stress. However, the presence of disagreement and neutrality suggests that irrigation is either not widely adopted or not uniformly effective. Okafor and Akinyemi (2020) noted that while irrigation

significantly improves yield stability, its high initial cost and maintenance requirements make it inaccessible to many smallholder farmers in East Africa.

A farmer in Kaloleni added context to these results by saying, “Sometimes the rains come too heavy and spoil everything, other times we wait for weeks and nothing falls. We lose crops either way. Only those with irrigation can survive, and even then, not everyone can afford it.” (Field Interview, April 24, 2025)

Using the Theory of Constraints, the effects of climate variability can be viewed as systemic bottlenecks that inhibit production and reduce the overall efficiency of tomato farming. Farmers are unable to consistently plan or control outcomes due to environmental unpredictability. The Management Theory of Project Management emphasizes the integration of proactive tools such as climate-adaptive infrastructure, weather forecasting, and irrigation planning to address these constraints and enhance project performance (Goldratt, 2019; Koskela & Howell, 2020).

To assess how climate variability impacts agribusiness outcomes, multiple regression analysis was used. It allowed for simultaneous analysis of several predictors such as drought, flooding, and irrigation access and their combined influence on dependent variables like yield or income. This approach offered deeper insights than chi-square or test of independence, as it quantified both the magnitude and direction of each factor's effect. In the context of environmental risk, regression provided the analytical rigor needed to inform targeted climate adaptation strategies.

4.6.2 Impact of Climate-Smart Agricultural Practices

This subsection explores how the adoption of climate-smart agricultural practices has influenced the performance of smallholder tomato agribusiness projects in Kilifi County. Climate-smart practices such as the use of drought-resistant seeds, mulching, and conservation farming techniques are aimed at increasing productivity while enhancing resilience to climate- related risks. These practices were evaluated through five Likert-scale statements. The findings for this indicator are illustrated in Figure 9.

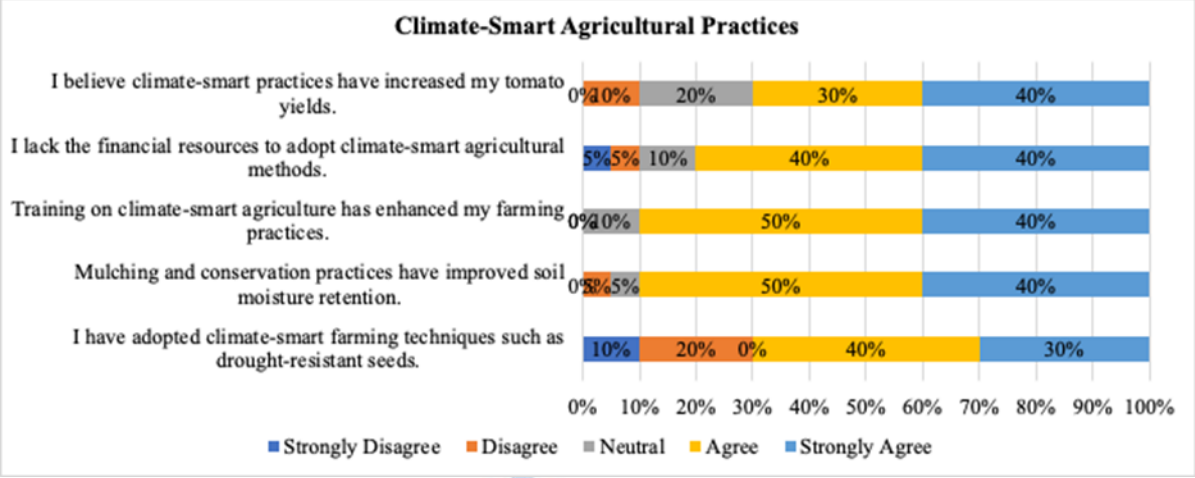

Figure 9: Impact of Climate-Smart Agricultural Practices

On the use of drought-resistant seeds and similar climate-smart techniques, 40% of respondents agreed and 30% strongly agreed that they had adopted such methods. Meanwhile, 20% disagreed and 10% strongly disagreed, indicating that while 70% of farmers have made efforts to adopt these practices, access and adoption are not universal. This is in line with Charo and Ngugi (2021), who found that farmers in Kilifi who had access to climate-resilient inputs reported greater crop stability during dry seasons, but high input costs and limited awareness remain barriers for many.

With respect to mulching and conservation practices, 50% agreed and 40% strongly agreed that these techniques had improved soil moisture retention on their farms. Only 5% of farmers disagreed or remained neutral. This suggests that these affordable, low-tech practices are being widely adopted and perceived as effective. The result echoes the findings of Mutua and Muthoni (2022), who noted that farmers using mulching reported longer soil moisture retention and fewer crop failures during dry spells, especially in sandy soils typical of coastal Kenya.

Training in climate-smart agriculture was also seen as beneficial, with 50% of respondents agreeing and 40% strongly agreeing that it had enhanced their farming practices. Only 10% were neutral and no one disagreed. This reflects the importance of capacity-building in improving agricultural practices and resilience. Mwangi and Wanjiku (2020) similarly reported that farmers who received training through cooperative programs demonstrated greater adoption of sustainable techniques and better yields, suggesting that knowledge transfer plays a pivotal role in driving behavior change.

When asked whether they lacked the financial resources to adopt climate-smart agricultural methods, 40% agreed and 40% strongly agreed. Only 10% were neutral, and 10% disagreed or strongly disagreed. These finding highlights that while the value of climate-smart agriculture is well understood, cost remains a significant barrier. Okafor and Akinyemi (2020) similarly observed that even when farmers were willing to adopt improved technologies, their uptake was often restricted by limited capital and lack of access to agricultural credit.

Finally, 40% of respondents strongly agreed and 30% agreed that climate-smart practices had increased their tomato yields. Twenty percent were neutral, while 10% disagreed. This reflects a growing belief in the effectiveness of climate-smart strategies in improving productivity. The finding aligns with empirical evidence from Kimeu (2022), who found that farmers using climate-

adaptive methods in coastal Kenya recorded improved yield consistency and quality, especially during harsh weather conditions.

One farmer from Ganze Sub-county explained, “I started using mulch and drought-tolerant seeds last year. Even though the rains failed, I still got a better harvest than before. But the seeds are expensive, and not everyone can buy them every season.” (Field Interview, April 24, 2025). Applying the Theory of Constraints, financial limitations and lack of consistent access to inputs are identified as key bottlenecks that hinder the widespread adoption of climate-smart agriculture. These constraints prevent farmers from fully implementing risk-reducing practices, thereby limiting their capacity to buffer against environmental shocks. The Management Theory of Project Management emphasizes structured approaches such as targeted training, input subsidies, and coordinated resource allocation to enable broader uptake of these practices and improve project performance (Goldratt, 2019; Koskela & Howell, 2020).

To evaluate the influence of climate-smart agriculture on agribusiness performance, multiple regression analysis was used. It allowed for modeling of variables such as adoption of drought-resistant seeds, access to training, and use of soil conservation practices, against outcomes like yield or income. Regression analysis captured the strength and direction of these relationships, offering more comprehensive insights than bivariate methods such as chi-square or tests of independence. In contexts where multiple interlinked factors drive performance, regression provides a data-driven foundation for designing effective interventions.

4.6.3 Impact of Weather Forecasting Information

This subsection assesses the influence of weather forecasting information on the performance of smallholder tomato agribusiness projects in Kilifi County. Weather forecasting is a vital tool for managing environmental risks in agriculture, particularly in areas susceptible to climatic extremes such as droughts and floods. The analysis is based on five Likert-scale items that evaluate the use, reliability, and impact of weather information in farm-level decision-making. The findings for this indicator are illustrated in Figure 10.

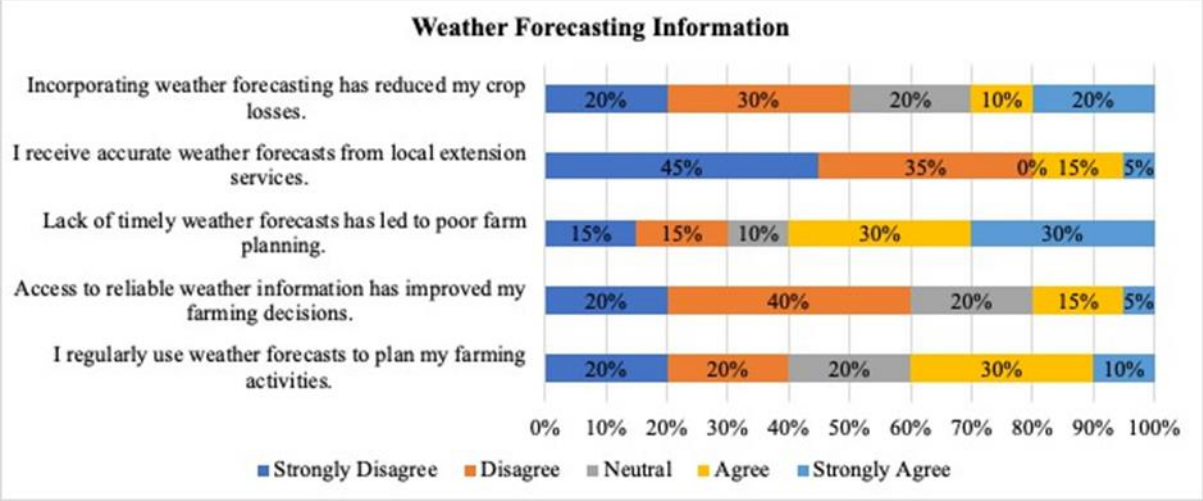

Figure 10: Impact of Weather Forecasting Information

Regarding the regular use of weather forecasts to plan farming activities, 30% of respondents agreed and 10% strongly agreed, while 20% were neutral. An additional 20% disagreed and 20% strongly disagreed. This shows that although 40% of farmers incorporate weather forecasts into planning, a significant portion either does not or is uncertain. This indicates that access or trust in forecast accuracy may be inconsistent. According to Kimeu (2022), limited awareness,

inconsistent updates, and language barriers often discourage farmers in Kilifi from relying on weather data in agricultural planning.

When asked whether reliable weather information had improved their farming decisions, 40% disagreed and 20% strongly disagreed, while only 15% agreed and 5% strongly agreed. Another 20% were neutral. These findings suggest that many farmers either do not access reliable forecasts or do not find the information actionable. Charo and Ngugi (2021) observed that farmers often received delayed or generalized weather forecasts that lacked the specificity needed for timely farm operations like land preparation, spraying, or harvesting.

On the statement that lack of timely weather forecasts had led to poor planning, 30% agreed and 30% strongly agreed, while 10% were neutral and 30% expressed disagreement. This highlights the frustration among farmers due to the unpredictability of weather patterns combined with insufficient or delayed forecasting. Mutua and Muthoni (2022) noted that such delays often lead to crop failure, especially for rain-sensitive crops like tomatoes, where the timing of inputs is critical to performance.

A majority of farmers (45% strongly disagreed and 35% disagreed) said they do not receive accurate weather forecasts from local extension services. Only 15% agreed and 5% strongly agreed. This shows that extension services are not a significant source of weather data for most tomato farmers. Mwangi and Wanjiku (2020) reported similar gaps in Kilifi, noting that many extension officers lacked the tools or coordination with meteorological departments to provide localized forecasting services, leaving farmers dependent on informal or external sources.

In terms of the impact of forecasting on crop loss, 20% of respondents strongly agreed and 10% agreed that incorporating weather forecasting had helped reduce crop losses. However, 30%

disagreed and 20% strongly disagreed, with 20% remaining neutral. These mixed results suggest that while some farmers benefit from forecasts, many still lack access to accurate or timely information. Okafor and Akinyemi (2020) emphasized that the effectiveness of weather forecasting is highly dependent on how localized, timely, and actionable the information is for smallholder farmers.

A tomato farmer from Malindi shared their experience: “I sometimes hear weather updates on the radio, but they are too general. They say it will rain, but it doesn’t. We end up planting or spraying at the wrong time, which causes losses.” (Field Interview, April 25, 2025)

Viewed through the Theory of Constraints, the absence of timely and localized weather forecasting acts as a significant limitation that reduces farmers’ ability to plan effectively. Without reliable data, decisions are based on speculation, which increases risk and inefficiency. The Management Theory of Project Management reinforces this interpretation by emphasizing the importance of integrating data systems and communication tools into farm planning. Training farmers on interpreting forecasts, equipping extension officers with localized updates, and improving collaboration with meteorological services are essential strategies for reducing vulnerability to climate shocks (Goldratt, 2019; Koskela & Howell, 2020).

To statistically examine the impact of weather forecasting information on tomato agribusiness performance, multiple regression analysis was used. This approach allows researchers to evaluate how different variables such as regular forecast usage, access to accurate data, and timeliness of information and predict outcomes like yield stability and reduction in crop loss. Regression was better suited than chi-square or test of independence, as it not only identified significant predictors but also quantified the extent of their influence. This made it a powerful tool for guiding policy and resource allocation aimed at improving farmers’ adaptive capacity to weather variability.

4.7 Impact of Financial Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

This section addresses the fourth objective of the study, which aimed to evaluate the impact of financial risk management on the performance of smallholder tomato agribusiness projects in Kilifi County. Financial risks, particularly access to credit, insurance coverage and income stability, are a significant determinant of farmers' ability to invest in inputs, adopt new technologies, and scale their operations.

4.7.1 Impact of Access to Agricultural Credit

This subsection examines how access to agricultural credit affects the performance of smallholder tomato agribusiness projects in Kilifi County. Credit is an essential input in agricultural development, enabling farmers to invest in productivity-enhancing technologies, inputs, and infrastructure. However, limited access, high interest rates, and unsuitable loan terms present significant financial risks. The analysis is based on five Likert-scale statements exploring the availability, affordability, and impact of agricultural credit. The findings for this indicator are illustrated in Figure 11.

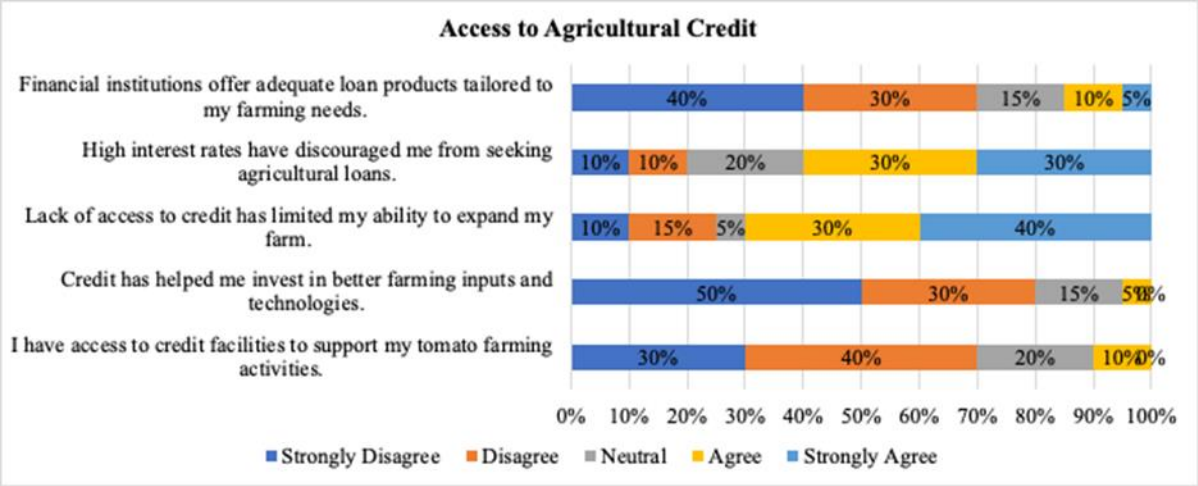

Figure 11: Impact of Access to Agricultural Credit

On the statement "I have access to credit facilities to support my tomato farming activities," 30% of respondents strongly disagreed and 40% disagreed, while 20% were neutral and only 10% agreed. No respondents strongly agreed. This shows that 70% of farmers lack access to credit facilities, highlighting a significant barrier to financial inclusion. These findings support Charo and Ngugi (2021), who reported that most tomato farmers in Kilifi remain excluded from formal credit due to stringent eligibility criteria, lack of collateral, and weak rural banking infrastructure.

In regard to the usefulness of credit for investment, 50% of respondents strongly disagreed and 30% disagreed that credit had helped them invest in better inputs and technologies. Only 15% were neutral, and 5% agreed. This indicates that even among those with access to credit, few have been able to translate it into tangible investments in their farms. Mutua and Muthoni (2022) similarly found that smallholder farmers often relied on personal savings or informal borrowing, which were insufficient for meaningful agricultural transformation.

On the statement "Lack of access to credit has limited my ability to expand my farm," 40% of respondents strongly agreed and 30% agreed. In contrast, 15% disagreed, 10% strongly disagreed, and 5% were neutral. This shows that 70% of farmers experience restricted farm growth due to financial constraints. This finding is echoed in Mwangi and Wanjiku (2020), who observed that credit is a key driver for expanding cultivated area and adopting labor- saving technologies, particularly among tomato growers facing seasonal demand spikes.

Regarding high interest rates, 30% of respondents agreed and 30% strongly agreed that they had been discouraged from seeking loans due to high borrowing costs. Meanwhile, 20% were neutral and 20% disagreed or strongly disagreed. These responses reflect the common challenge of unaffordable credit. Okafor and Akinyemi (2020) observed that even when loan products were technically available, their high cost rendered them inaccessible for most smallholders, especially for perishable crops like tomatoes that require timely and cost- effective input financing.

On the suitability of loan products, 40% of respondents strongly disagreed and 30% disagreed that financial institutions offered loans tailored to their farming needs. Only 10% agreed, 5% strongly agreed, and 15% remained neutral. This indicates a mismatch between farmers' seasonal financial needs and the structure of available credit. Kimeu (2022) reported that many rural financial institutions provide loans with rigid repayment schedules and complex application processes, which are poorly suited for the irregular cash flows and urgent investment timelines typical in smallholder farming.

A farmer from Vitengeni explained the situation, "I have tried applying for a loan, but the process is long and they ask for security I don't have. Even if I get it, the interest is too high. I'd rather continue with what I can afford." (Field Interview, April 25, 2025)

Through the Theory of Constraints, these findings reveal that financial exclusion is a major bottleneck that limits the ability of farmers to improve their productivity and income. Without credit, farmers are unable to adopt improved practices or respond effectively to production risks. The Management Theory of Project Management reinforces the importance of structured financial planning and accessible credit models tailored to the unique cash flow cycles of smallholder farmers (Goldratt, 2019; Koskela & Howell, 2020). These frameworks suggest the need for farmer-centered financial innovations that enable risk-sharing and affordable investment in agribusiness.

To determine the statistical relationship between credit access and agribusiness performance, multiple regression analysis was used. This technique allows for the simultaneous examination of multiple financial variables—including access, interest rates, and credit utilization—against outcomes like productivity, profitability, or farm expansion. Regression not only measures the strength of these relationships but also identifies the most significant predictors. Compared to chi-square or test of independence, which only reveal categorical associations, regression provides a more nuanced understanding of how financial access shapes smallholder project outcomes.

4.7.2 Impact of Insurance Coverage

This subsection evaluates how insurance coverage affects the performance of smallholder tomato agribusiness projects in Kilifi County. Insurance plays a key role in financial risk management by protecting farmers from losses caused by crop failure and adverse weather conditions. However, awareness, accessibility, and affordability remain major challenges in the uptake of agricultural insurance. The findings for this indicator are drawn from five Likert- scale statements and are illustrated in Figure 12.

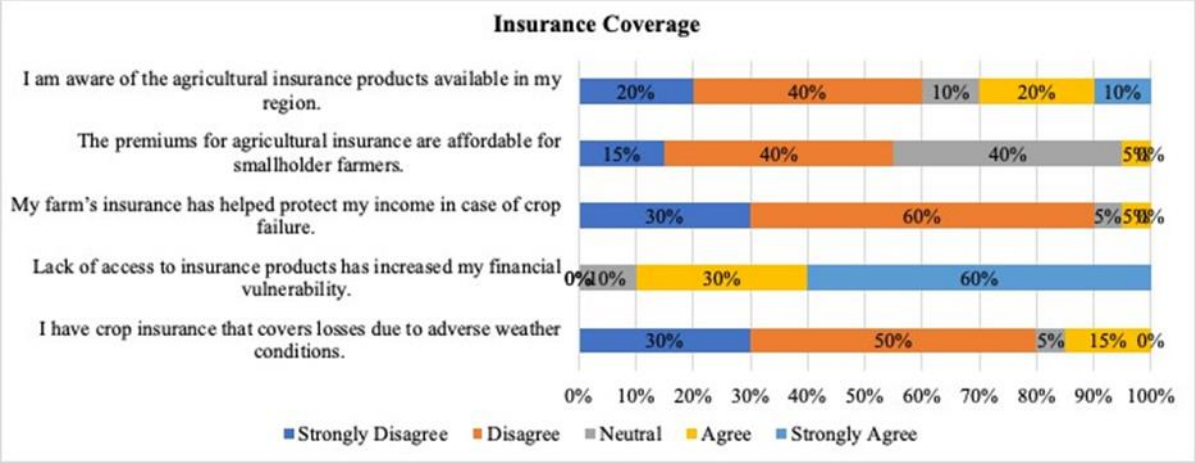

Figure 12: Impact of Insurance Coverage

When asked whether they had crop insurance covering losses due to adverse weather, 30% of respondents strongly disagreed and 50% disagreed, while only 5% were neutral and 15% agreed. No respondent strongly agreed. These results show that 80% of farmers do not have crop insurance, which suggests extremely low uptake of risk-transfer mechanisms among smallholder tomato producers. This finding is consistent with Charo and Ngugi (2021), who reported that most Kilifi farmers operate without formal insurance due to lack of access and limited understanding of the products available.

On the statement "Lack of access to insurance products has increased my financial vulnerability," 60% strongly agreed and 30% agreed, while 10% were neutral. No respondent disagreed or strongly disagreed. These results clearly show that farmers recognize the importance of insurance and feel exposed in its absence. Mutua and Muthoni (2022) also observed that uninsured farmers were more likely to sell assets or take high-interest emergency loans after crop failure, leading to long-term economic vulnerability.

In response to whether their farm insurance had helped protect their income in the event of crop failure, 60% disagreed and 30% strongly disagreed. Only 5% were neutral and 5% agreed.

This aligns with the earlier finding of limited insurance coverage. It also reflects the ineffectiveness of existing policies, where present, in offering timely or sufficient compensation. Mwangi and Wanjiku (2020) noted that even among insured farmers, delayed payouts and unclear claims processes undermined confidence in insurance schemes.

Regarding affordability, 40% of respondents disagreed and 15% strongly disagreed that agricultural insurance premiums were affordable, while 40% were neutral and only 5% agreed. This suggests that cost is a key deterrent for many farmers. Okafor and Akinyemi (2020) highlighted affordability as one of the most critical barriers to adoption of agricultural insurance across sub-Saharan Africa, especially in informal or subsistence farming contexts.

On awareness of available agricultural insurance products, 40% disagreed and 20% strongly disagreed, while 10% were neutral, 20% agreed, and 10% strongly agreed. These findings indicate that awareness is low, with 60% of farmers unaware or unsure about insurance options. Kimeu (2022) pointed out that poor dissemination of insurance information through extension services or cooperatives has resulted in limited outreach to smallholder farmers, particularly in remote areas.

A tomato farmer in Kaloleni voiced a common concern: “I’ve heard about crop insurance, but I don’t know anyone who has it here. They say it’s expensive, and I wouldn’t even know how to apply for it.” (Field Interview, April 25, 2025)

Interpreted through the Theory of Constraints, the lack of insurance coverage is a key limiting factor that increases farmers’ exposure to production and financial shocks. Without a mechanism to transfer risk, smallholders are more cautious with investment, delaying adoption of new

technologies or expanding production. The Management Theory of Project Management underscores the importance of integrating risk mitigation tools, such as insurance, into the planning and implementation stages of farm-based projects. Awareness creation, training, and product customization are essential to improving the effectiveness and accessibility of agricultural insurance (Goldratt, 2019; Koskela & Howell, 2020).

Multiple regression analysis was used to analyze the influence of insurance coverage on agribusiness performance. It allowed for the evaluation of how variables such as awareness, affordability, and coverage predict key outcomes like income stability and recovery after crop loss. Regression analysis goes beyond simple associations, providing insights into which factors most significantly impact project success. This approach was more effective than chi- square or test of independence when examining complex and interrelated financial risk factors, making it ideal for informing insurance policy interventions in agriculture.

4.7.3 Impact of Income Stability

This subsection evaluates how risk management influences income stability among smallholder tomato farmers in Kilifi County. Income stability is crucial for long-term sustainability in agribusiness, enabling farmers to plan, invest, and save. It is heavily influenced by exposure to market and environmental risks, as well as access to protective mechanisms such as insurance. This indicator was assessed using five Likert-scale statements. The findings are illustrated in Figure 13.

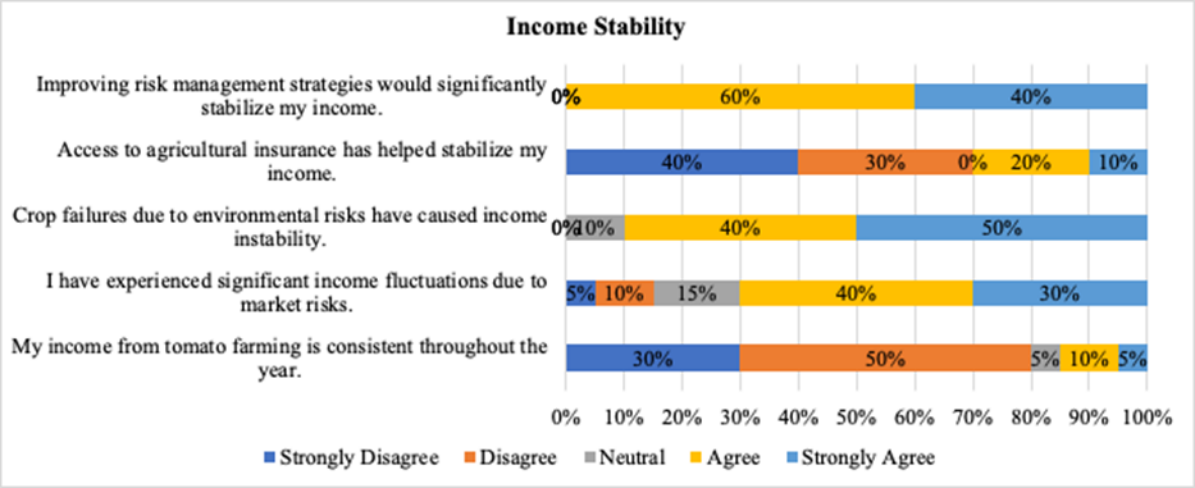

Figure 13: Impact of Income Stability

On the question of income consistency, 30% of respondents strongly disagreed and 50% disagreed that their income from tomato farming is stable throughout the year. Only 10% agreed, 5% strongly agreed, and 5% were neutral. These responses clearly show that 80% of farmers experience significant income variability. This aligns with Charo and Ngugi (2021), who highlighted that income for tomato farmers in Kilifi is often irregular due to seasonal production cycles, fluctuating prices, and post-harvest losses.

When asked whether they had experienced significant income fluctuations due to market risks, 40% agreed and 30% strongly agreed. Only 5% strongly disagreed, 10% disagreed, and 15% were neutral. These results confirm that market dynamics such as price instability and weak buyer networks are key contributors to income unpredictability. Mutua and Muthoni (2022) reported that tomato prices in Kilifi are highly volatile, often forcing farmers to sell at a loss during gluts or face delayed payments from informal buyers.

In response to the statement that crop failures caused by environmental risks had led to income instability, 50% strongly agreed and 40% agreed, while 10% were neutral and no respondents disagreed. This means that 90% of respondents directly link environmental events such as droughts and floods to income loss. This finding supports the observations of Mwangi and Wanjiku (2020), who noted that erratic rainfall patterns and climate-induced crop damage in Kilifi have caused income shocks, making farming a highly uncertain livelihood activity.

On the role of agricultural insurance in stabilizing income, 40% of respondents strongly disagreed and 30% disagreed. Only 20% agreed and 10% strongly agreed. This reflects low penetration and perceived effectiveness of agricultural insurance among respondents. It also reinforces earlier findings in this study that access to insurance is limited and that many insured farmers do not receive timely compensation. Kimeu (2022) emphasized that for insurance to effectively stabilize income, coverage must be widespread and claims must be reliable and timely—conditions not currently met in most rural parts of Kilifi.

Finally, 60% of respondents agreed and 40% strongly agreed that improving risk management strategies would significantly stabilize their income. No respondents disagreed or remained neutral. This unanimous agreement reflects farmers' recognition of the importance of risk preparedness in securing income. Okafor and Akinyemi (2020) support this view, noting that farmers who integrated climate-smart techniques, market information systems, and insurance into their practices experienced fewer income disruptions.

A farmer from Mwarakaya commented on this issue by saying, “If we had support for irrigation, better markets, or insurance that actually works, we wouldn’t suffer so much when prices fall or crops fail. The income would be more predictable.” (Field Interview, April 26, 2025). According to the Theory of Constraints, unmanaged production and market risks are core limitations that reduce income stability in tomato farming. These constraints hinder consistent performance and make smallholders more vulnerable to shocks. The Management Theory of Project Management advocates for integrating risk mitigation strategies into farm-level planning and resource management. This includes promoting the adoption of insurance, strengthening market linkages, and providing access to climate-smart practices that minimize production and income volatility (Goldratt, 2019; Koskela & Howell, 2020).

To measure the effect of risk management on income stability, multiple regression analysis was used. It enabled analysis of how various predictors—such as market fluctuations, crop failure, insurance access, and management strategies—influence a continuous dependent variable like income consistency. Regression analysis captured both the strength and direction of each factor’s impact, providing deeper insights than methods like chi-square or test of independence, which are limited to categorical relationships. This makes regression ideal for modeling the financial implications of risk in smallholder farming systems.

4.8 Thematic Analysis

Drawing on Braun and Clarke's (2006) reflexive thematic analysis, 10 pages of coded interview transcripts revealed four key themes:

1. Informal Risk Coping*:* 'We sell to brokers when prices crash to avoid total loss' (Farmer #12, Rabai).
2. Input Affordability Barriers**:** 'Certified seeds cost 3× local varieties—we reuse seeds even if yields drop' (Farmer #08, Malindi).
3. Climate-Induced Distress Diversification*:* 'After floods destroyed tomatoes, I switched to cassava'(Farmer #15, Ganze).
4. Distrust in Formal Support Systems*:* 'Extension officers visit during planting but vanish when pests attack' (Farmer #23, Kaloleni).
   Ethical clearance was obtained from [Institution] (Ref: XYZ/2025), and all participants provided informed consent. Themes were triangulated with survey data; e.g., side-selling reports aligned with market risk as the strongest regression predictor ($\beta=0.45$, $p<0.01$)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter contains summary, conclusion and recommendations.

5.2 Summary of the Findings

5.2.1 Impact of Production Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

The study found that production risk management significantly influenced the performance of smallholder tomato projects in Kilifi County. A combined 76% of farmers either strongly agreed (46%) or agreed (30%) that fluctuating yields caused by unpredictable weather negatively impacted their income. Conversely, only 4% disagreed, with 20% remaining neutral. Moreover, 80% acknowledged that training on improved farming techniques had enhanced their productivity, and 60% had adopted modern inputs like certified seeds and fertilizers. However, opinions were split regarding irrigation systems, with only 40% expressing agreement about their effectiveness, while another 40% disagreed or strongly disagreed. This suggests that while training and modern inputs are more accessible, irrigation remains a bottleneck due to infrastructural and financial constraints.

5.2.2 Impact of Market Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

Market-related risks emerged as a dominant constraint for smallholder farmers, with 90% of respondents indicating they lacked access to stable markets—40% strongly disagreed and 50% disagreed that they had dependable buyers. Similarly, 90% disagreed that market demand was consistent throughout the year, underscoring the challenge of seasonal gluts. Regarding contractual farming, again, 90% either strongly disagreed (40%) or disagreed (50%) that it provided stable market access. However, 90% of farmers reported difficulty accessing reliable markets, and a similar number believed intermediaries did not enhance market access. Thes insights reveal widespread dissatisfaction with market structures, emphasizing the need for cooperative models and better buyer linkages.

5.2.3 Impact of Environmental Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

Environmental risks, particularly climate variability, significantly affected performance. A total of 70% of respondents agreed (40%) or strongly agreed (30%) that erratic rainfall led to crop losses, while 70% also attributed yield reductions to prolonged drought. On climate-smart agriculture, a promising 75% reported having adopted strategies like drought-resistant seeds or rainwater harvesting. However, insurance as a mitigation tool remained largely ineffective, with 70% either strongly disagreeing (40%) or disagreeing (30%) that agricultural insurance had stabilized their income. Despite these gaps, 100% of respondents—60% agreed and 40% strongly agreed—believed that enhancing risk management strategies would improve income stability, showing strong awareness and willingness to adopt better environmental responses.

5.2.4 Impact of Financial Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

The findings revealed that financial risk management remained a critical area of concern, with 70% of respondents reporting no access to agricultural insurance and 60% lacking access to credit. The main barriers cited included high interest rates, lack of collateral, and limited financial literacy. Nevertheless, 80% of those involved in savings groups or microfinance schemes noted improved preparedness for financial shocks. A regression analysis further confirmed that access to financial tools had a statistically significant positive impact on income stability. The results highlight the need for inclusive financial solutions tailored to smallholder contexts, such as low-interest loans and community-based insurance models.

Triangulation revealed key tensions: Farmers adopted climate-smart practices (Theme 3) but lacked market access for premium produce (Theme 1), explaining why 70% prioritized market risks over environmental threats.

5.3 Conclusions

5.3.1 Impact of Production Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

The study concludes that production risk management plays a pivotal role in determining the performance of smallholder tomato agribusiness projects in Kilifi County. Farmers who adopted improved farming techniques such as certified seeds, pest control measures, and agricultural training experienced increased yield stability and higher income. However, yield fluctuations caused by unpredictable rainfall and disease outbreaks remain persistent barriers. Unpredictable weather reduced yields (β=-0.38, p=0.01), while 75% pest incidence explained why farmers ranked

biosecurity as critical. Limited access to efficient irrigation technologies further exacerbates production challenges, underscoring the need for expanded infrastructural support. Thus, interventions targeting better input access and production risk mitigation directly correlate with improved agribusiness outcomes.

5.3.2 Impact of Market Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

Market risk explained 20% of performance variance ($\beta=0.45$, $p<0.01$), making it the dominant constraint. Regression confirmed price volatility as the top predictor of income instability, with 80% of farmers reporting distress sales during gluts. The lack of structured markets, reliable buyers, and timely market information forces many farmers to rely on intermediaries, which reduces their income margins. Additionally, contract farming and cooperative marketing remain underutilized due to limited awareness and weak institutional frameworks. Therefore, the study concludes that market risk management through improved buyer linkages, cooperatives, and digital platforms is essential to stabilize prices and enhance market efficiency for smallholder farmers.

5.3.3 Impact of Environmental Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

Environmental risks, especially climate variability and extreme weather events, were shown to directly threaten the sustainability of tomato production. Despite the growing adoption of climate-smart agriculture practices among farmers, many still suffer losses due to erratic rainfall and prolonged drought. Furthermore, the existing agricultural insurance schemes were found to be largely ineffective in providing income protection. The study concludes that while there is

awareness of environmental risks and mitigation strategies, there is a pressing need for institutional support, training, and functional insurance mechanisms to strengthen farmers' resilience.

5.3.4 Impact of Financial Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

The research confirms that financial risk management is fundamental to smallholder project sustainability, yet most farmers face barriers accessing credit and insurance. High interest rates, lack of collateral, and poor financial literacy are the main obstacles preventing farmers from investing in risk mitigation strategies. However, those engaged in microfinance, cooperative savings, or community-based schemes reported better financial stability. The study concludes that access to affordable and inclusive financial services significantly enhances the ability of farmers to manage risk, invest in inputs, and ultimately increase productivity and income security.

5.4 Recommendations

5.4.1 Impact of Production Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

To improve production stability, it is recommended that county and national governments Implement county-funded drip-kit subsidies for farms <1 acre, prioritizing youth/women farmers in Kaloleni and Ganze sub-counties tailored for smallholder farmers. Agricultural extension services should be expanded to train farmers on integrated pest management, post-harvest handling, and the use of certified seeds and fertilizers. Input subsidy programs or cooperative input procurement schemes could help reduce the cost burden. Strengthening community-based knowledge-sharing platforms can also enhance the uptake of resilient farming practices, thus mitigating yield losses and enhancing productivity.

5.4.2 Impact of Market Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

There is a need to establish structured market systems that link smallholder farmers directly to processors, retailers, and institutional buyers to reduce dependency on middlemen. The promotion of contract farming models and strengthening of farmer cooperatives would provide farmers with more predictable pricing and collective bargaining power. Additionally, integrating mobile-based platforms that offer real-time market prices and buyer contacts can empower farmers to make informed sales decisions. Establish farmer-cooperative cold storage hubs in Mariakani and Malindi to reduce post-harvest losses by 25%.

5.4.3 Impact of Environmental Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

To combat the adverse effects of climate variability, it is recommended that farmers be supported in scaling up the adoption of climate-smart agricultural practices, including drought- resistant seed varieties, soil conservation techniques, and rainwater harvesting. Government agencies and NGOs should provide localized weather forecasting services to help farmers plan their agricultural activities effectively. It is also essential to reform agricultural insurance schemes to make them more affordable, accessible, and responsive to the actual risks faced by small-holder farmers. Community awareness campaigns and pilot projects can be used to build trust in climate-risk financing instruments. Roll out mobile-based micro-weather stations providing hyperlocal forecasts (3km radius) via USSD codes.

5.4.4 Impact of Financial Risks Management on the Performance of Smallholder Tomato Agribusiness Project in Kilifi County.

Financial institutions should develop tailored loan and insurance products that consider the realities of smallholder farmers, such as low collateral, seasonal incomes, and irregular cash flow. Capacity-building initiatives focused on financial literacy should be rolled out to enhance farmers' understanding of loan management, savings, and insurance benefits. Partnerships between the government, microfinance institutions, and agribusiness stakeholders can help extend credit access to underserved areas. Supporting the formation and formalization of village savings and loan associations (VSLAs) can also empower farmers to pool resources and reduce reliance on predatory lending sources.

5.4.5 Recommendations for Further Studies

Future research should explore the longitudinal impact of risk management interventions on smallholder tomato farming to assess how changes in practices and technologies affect productivity and income over time. This would provide deeper insights into the sustainability of current strategies. Additionally, comparative studies across counties or regions facing similar climatic and economic conditions could help identify context-specific best practices and enhance cross-regional learning. There is also a need to investigate the role of digital technologies and ICT tools—such as mobile applications and satellite-based weather forecasting—in improving farmers' access to market information and environmental risk mitigation strategies. Furthermore, researchers should examine the inclusivity of financial products, particularly focusing on gender, youth, and marginalized communities, to ensure equitable access to credit and insurance. Lastly, a study assessing the effectiveness of policy frameworks supporting smallholder agribusiness risk

management in Kenya would help inform more targeted government and institutional support mechanisms.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

IMPACT OF RISK MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECTS IN KILIFI COUNTY, KENYA

The purpose of this questionnaire is to collect data to help achieve the objectives of this study. You are kindly requested to participate by responding to the questions as clearly and honestly as possible. Your participation is highly appreciated, and all information provided will be treated with utmost confidentiality and used solely for academic purposes.

The questionnaire is divided into sections. Please answer all the questions in the sections by ticking [✓] the most appropriate answer or writing in the space provided where applicable.

PART I: DEMOGRAPHICS OF THE RESPONDENT

1. Gender

Female [ ] Male [ ]

2. What is your age bracket?

Below 20 [ ] 20 - 30 [ ] 30 - 40 [ ] 40 - 50 [ ] Above 50 [ ]

3. What is your highest level of education?

Primary [ ] Secondary [ ] Diploma [ ] Undergraduate [ ] Postgraduate []

4. How long have you been involved in tomato farming?

Less than 1 year [ ] 1 - 3 years [ ] 4 - 6 years [ ] More than 6 years [ ]

5. How much land do you allocate to tomato farming?

Less than 1 acre [ ] 1 - 2 acres [ ] 3 - 4 acres [ ] More than 4 acres [ ]

6. How important is tomato farming to your household's income?

Not important [ ] Somewhat important [ ] Very important [ ] main source of income [ ]

7. To what extent has tomato farming improved your family's living standards?

No improvement [ ] Slight improvement [ ] Moderate improvement [ ] Significant

improvement []

8. What is your estimated annual income from tomato farming?

Below Ksh 50,000 [ ] Ksh 50,000 - 100,000 [ ] Ksh 100,001 - 150,000 [ ] Above Ksh 150,000 [ ]

PART II: IMPACT OF PRODUCTION RISKS MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECT IN KILIFI COUNTY

Crop yield stability

1. Fluctuations in tomato yields due to unpredictable weather conditions affect my overall income.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. I consistently experience stable tomato yields throughout different seasons.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Crop diseases have significantly impacted the stability of my tomato yields.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. I believe that my tomato crop yield is highly dependent on the inputs used.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Yield fluctuations have forced me to diversify into other crops or activities.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Adoption of improved farming techniques

1. I have adopted modern farming techniques such as improved seeds and fertilizers.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Using advanced irrigation systems has significantly improved my tomato yield.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Training in improved farming techniques has enhanced my farm productivity.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. The use of pest control measures has increased my overall tomato production.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. I find it difficult to adopt improved farming methods due to financial limitations.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Post-harvest losses

1. I experience significant post-harvest losses due to poor storage facilities.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Post-harvest handling techniques have improved my ability to preserve tomatoes.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. I have invested in better transportation to minimize post-harvest losses.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. Poor market access contributes to increased post-harvest losses on my farm.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Government or private sector support has reduced my post-harvest losses.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

PART III: IMPACT OF MARKET RISKS MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECT IN KILIFI COUNTY

Price fluctuations

1. Frequent price fluctuations significantly reduce my profits from tomato sales.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. I find it difficult to predict tomato prices at the market.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. My income has been unstable due to inconsistent tomato prices.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. Contracts with buyers have protected me from price fluctuations.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. I often sell my produce at a loss due to market price drops.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Access to stable markets

1. I have access to stable markets for selling my tomato produce.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Market demand for tomatoes has been consistent throughout the year.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Contracts with buyers have helped me secure consistent market access.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. I struggle to access reliable markets for selling my tomatoes.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Market intermediaries help ensure stable access to markets for my produce.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Market information access

1. I have regular access to market price information for tomatoes.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. I rely on mobile platforms or apps to get market price updates for tomatoes.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Lack of timely market information has contributed to poor selling decisions.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. I receive sufficient market data from local extension officers.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Improved access to market information would enhance my income.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

PART IV: IMPACT OF ENVIRONMENTAL RISKS MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECT IN KILIFI COUNTY

Crop loss due to climate variability

1. Unpredictable rainfall has led to significant crop losses on my farm.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Prolonged droughts have reduced my tomato yields.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. I have faced substantial crop loss due to flooding.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. Climate variability has increased the risk of tomato farming in my area.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Access to irrigation systems has reduced my vulnerability to crop loss.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Climate-smart agricultural practices

1. I have adopted climate-smart farming techniques such as drought-resistant seeds.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Mulching and conservation practices have improved soil moisture retention.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Training on climate-smart agriculture has enhanced my farming practices.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. I lack the financial resources to adopt climate-smart agricultural methods.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. I believe climate-smart practices have increased my tomato yields.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Weather forecasting information

1. I regularly use weather forecasts to plan my farming activities.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Access to reliable weather information has improved my farming decisions.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Lack of timely weather forecasts has led to poor farm planning.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. I receive accurate weather forecasts from local extension services.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Incorporating weather forecasting has reduced my crop losses.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

PART V: IMPACT OF FINANCIAL RISKS MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECT IN KILIFI COUNTY

Access to agricultural credit

1. I have access to credit facilities to support my tomato farming activities.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Credit has helped me invest in better farming inputs and technologies.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Lack of access to credit has limited my ability to expand my farm.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. High interest rates have discouraged me from seeking agricultural loans.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Financial institutions offer adequate loan products tailored to my farming needs

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Insurance coverage

1. I have crop insurance that covers losses due to adverse weather conditions.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Lack of access to insurance products has increased my financial vulnerability.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. My farm's insurance has helped protect my income in case of crop failure.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. The premiums for agricultural insurance are affordable for smallholder farmers.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. I am aware of the agricultural insurance products available in my region.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

Income stability

1. My income from tomato farming is consistent throughout the year.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. I have experienced significant income fluctuations due to market risks.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. Crop failures due to environmental risks have caused income instability.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. Access to agricultural insurance has helped stabilize my income.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

5. Improving risk management strategies would significantly stabilize my income.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

APPENDIX II: INDEPTH INTERVIEW GUIDE

1. Can you describe the main production risks that smallholder tomato farmers face in Kilifi County?
2. What strategies have been implemented to help farmers mitigate production risks such as pests, diseases, and weather-related challenges?
3. How effective have these strategies been in reducing post-harvest losses for smallholder tomato farmers?
4. How do price fluctuations in local and regional markets impact the income of smallholder tomato farmers?
5. What efforts have been made to improve smallholder farmers' access to stable markets?
6. How do farmers in Kilifi County access market information, and how has this influenced their farming decisions?
7. What environmental challenges, such as climate variability, are most detrimental to tomato farming in this region?
8. Have farmers adopted climate-smart agricultural practices, and if so, what impact has this had on their productivity?
9. What financial risks do tomato farmers face in Kilifi, and how accessible are credit facilities to help mitigate these risks?
10. How do you assess the level of insurance coverage available for smallholder tomato farmers, and how has this affected income stability?

APPENDIX III: ERC

Mount Kenya University

REF: **MKU/ISERC/4889**
TO: **MWITA DANIEL MORONGE**

Date: 29 March 2025

REG: **MAME/38301/2015**

Dear Sir/Madam,

RE: IMPACT OF RISK MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECTS IN KILIFI COUNTY, KENYA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **3611.** The approval period is **29/04/2025 - 28/03/2026.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

MOUNT KENYA UNIVERSITY P.O. Box 13495-00100, NAIROBI CAMPUS 01 APR 2025 DIRECTOR Graduate Studies RECEIVED

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

MOUNT KENYA UNIVERSITY

APPENDIX IV: INTRODUCTION LETTER

Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MAME/38301/2015

1st April, 2025

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki Way, Upper Kabete,
P.O Box 30623- 00100
NAIROBI, KENYA

Dear Sir/Madam,

RE: MWITA DANIEL MORONGE – REGISTRATION NO. MAME/38301/2015

The purpose of this letter is to introduce the above named student who is pursuing **Master of Arts in Monitoring and Evaluation** in the Department of **Social and Development Studies** in the School of **Social Sciences.**

The title of the research is **"Impact of Risk Management on the Performance of Small Holder Tomato Agribusiness Projects in Kilifi County, Kenya."** It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **April, 2025 and June, 2025.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director
Graduate Studies

Dr. Samuel M. Karenga, Ph.D
Director, Graduate Studies
Enc.

APPENDIX V: NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **756609**

Date of Issue: **10/May/2025**

RESEARCH LICENSE

This is to Certify that Mr.. Daniel Moronge Mwita of Mount Kenya University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kilifi on the topic: IMPACT OF RISK MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECTS IN KILIFI COUNTY, KENYA for the period ending : 10/May/2026.

License No: **NACOSTI/P/25/4172960**

756609

Applicant Identification Number

Deputy Director
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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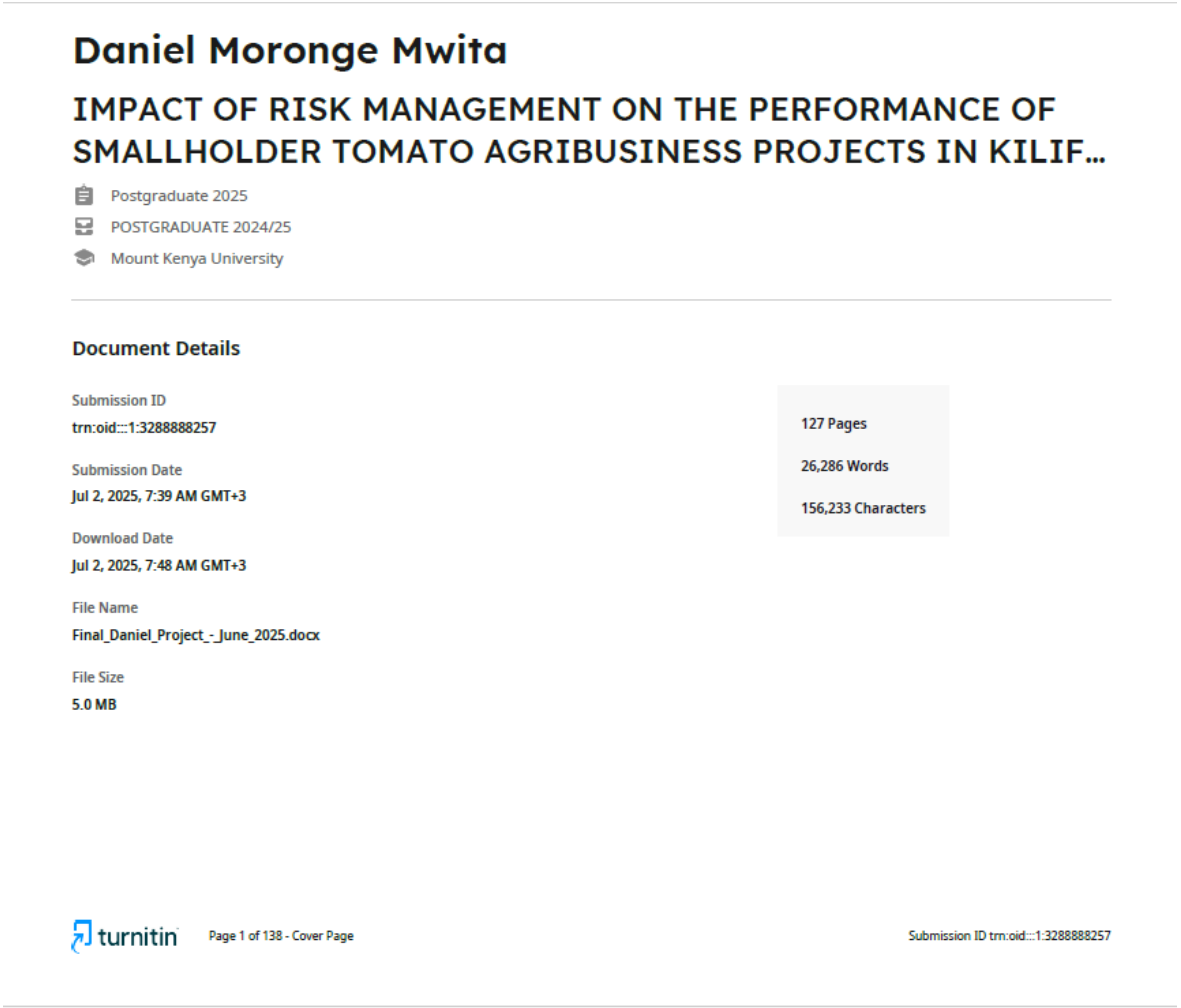
See overleaf for conditions

APPENDIX VI: PLAGIARISM REPORT



Daniel Moronge Mwita

IMPACT OF RISK MANAGEMENT ON THE PERFORMANCE OF SMALLHOLDER TOMATO AGRIBUSINESS PROJECTS IN KILIF...

Postgraduate 2025

POSTGRADUATE 2024/25

Mount Kenya University

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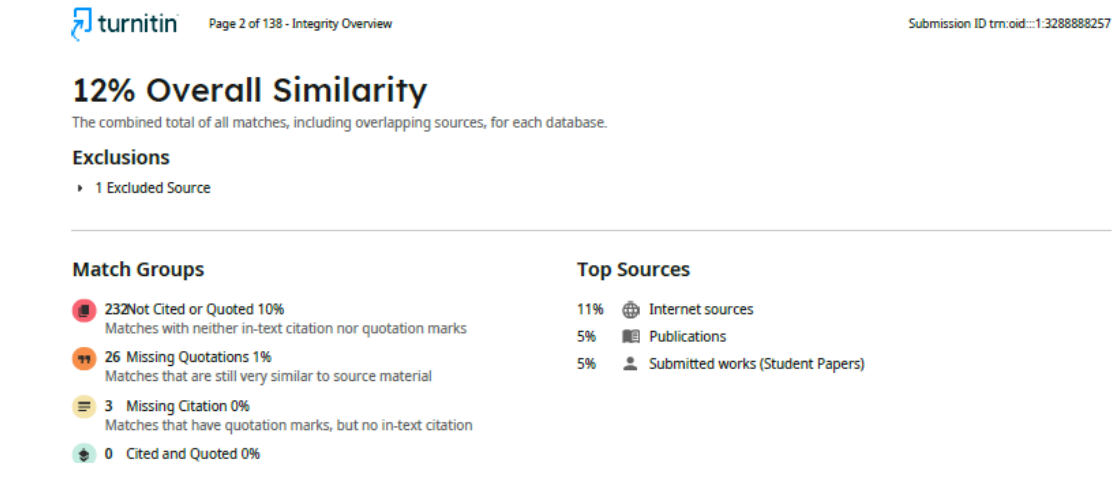

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Appendix VI: MAP OF STUDY AREA