

Impact of Agricultural Risks on the Livelihoods of Small-scale Farmers and Adaptation Strategies for Sustainable Livelihoods in Embu County, Kenya

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ABSTRACT

Small-scale agriculture is central to food production and rural livelihoods in Kenya, yet farmers face multiple agricultural risks, including unpredictable rainfall, pests and diseases, fluctuating market prices, limited access to credit and farm inputs and soil degradation, which threaten their productivity and livelihood sustainability. This study examined the impact of agricultural risks on the livelihoods of small-scale farmers in Embu County, Kenya, and explored the adaptation strategies they employ. Data were collected from 118 small-scale farmers using questionnaires and from 10 key informants through interviews. Quantitative data were analyzed using descriptive statistics and Ordinary Least Squares (OLS) regression, while qualitative data were analyzed thematically. The findings show that farmers adopt strategies such as livelihood diversification through off-farm income, crop diversification, improved crop varieties, irrigation, and participation in cooperatives. However, the effectiveness of these strategies is constrained by financial, technical, and institutional barriers. The study concludes that strengthening farmers' resilience requires coordinated support from national and county governments, together with the private sector, to enhance their adaptive capacity and promote sustainable livelihoods.

Keywords: *Agricultural Risks; Small-scale Farmers; Livelihood Sustainability; Adaptation Strategies; Kenya*

INTRODUCTION

Agriculture remains the backbone of rural livelihoods in sub-Saharan Africa, employing a substantial proportion of the population and serving as the primary source of income and food security for rural households (FAO, 2021; World Bank, 2022). In Kenya, agriculture employs over 65 per cent of the country's rural population (Sagwe et al., 2023; Ministry of Agriculture and Livestock Development, 2024). The World Meteorological Organization (2023) reported that approximately 98 percent of Kenya's agriculture is rain-fed reliant, rendering it highly vulnerable to climate variability and change. Beyond the climatic shocks, the small-scale agricultural production is further constrained by other factors such as soil degradation, pest and disease outbreaks, rising input costs and diminishing farm sizes, all of which adversely affect farm incomes and livelihood sustainability for the small-scale farmers (Annappa et al., 2023).

Climate change often manifests through increasing climatic variability that include recurrent droughts, extreme temperatures, floods, pest and disease outbreaks, all of which adversely affect agricultural productivity (Kumar et al., 2024). These kinds of pressures are compounded by soil degradation resulting from intensive land use and shrinking farm sizes driven by population growth, further constraining small-scale farmers' livelihood sustainability (Van Den Berg, 2013). The declining farm incomes impose significant financial strain on smallholder households which exacerbates food insecurity, adversely effecting health outcomes and increasing their risk of sliding into chronic poverty (Komarek, Pinto, & Smith, 2020).

Devising tactics of mitigating these agricultural risks is crucial and has become an important part of the small-scale farmers' strategy as they search for solutions to stabilize their incomes. According to Barham et al. (2014) and Bryan, Ringler and Herrera (2013) farmers are always looking for assured ways of stabilizing their farm incomes by constantly exploring diverse strategies to manage agricultural risks. Risk management strategies vary across farmers, reflecting diverse approaches to agricultural uncertainties (USDA, 2025). Identifying effective long-term strategies enhances small scale farmer's adaptability, supports sustainable livelihoods and remains a priority for research and policy (Kalele et al., 2021).

Numerous studies Babatunde et al. (2017), Doggalli (2024), Tei and Wswa (2024) and Akuja and Kandagor (2024) found out that due to uncertainties involved when choosing methods for mitigating agricultural risks, farmers opt for low returns and less risks instead of settling for options that have more risks such as upcoming technologies that may give them more returns. However, Babatunde (2017) and Doggalli (2024) note a growing adoption of off-farm income diversification among small-scale farmers' households, as it provides a buffer against agricultural risks and supplements farm earnings. Farmers often rely on self-devised strategies to manage agricultural risks due to limited government support through insurance, extension, or advisory services. Off-farm income diversification is defined as economic activities outside the farm that supplement farm earnings, it is recognized as a key risk mitigation and livelihood strategy (Deressa, Ringler, & Hassan, 2010; Kune et al., 2012).

The concept of relying on agriculture as the sole source of income is shifting among Kenyan small-scale farmers. In Embu County, there is an increase of adoption of non-farm activities to supplement their farm earnings. This strategy is lauded by researchers because income from off-farm activities provides crucial support for household expenses amid declining agricultural income (Velandia et al., 2009; Sadiya & Man, 2009; Ellis & Freeman, 2016). The need to have such appropriate adaptation strategies that assist the small-scale farmers stabilize their incomes cannot be overemphasized (Alam et al., 2017; Khanal et al., 2018). Given this background, the paper makes three key contributions. First, it examines the strategies used by small-scale farming households to mitigate agricultural risks and achieve stable incomes, thereby contributing to the literature on sustainable livelihoods. Second, it employs a robust econometric approach to appraise livelihood adaptation strategies among small-scale farmers in Embu County, specifically analyzing the extent to which agricultural risk management practices influence farm income levels and overall household resilience. Finally, the paper proposes practical agricultural risk management and coping strategies that farmers can adopt to improve their incomes and promote sustainable livelihoods.

Statement of the problem

Small-scale farming in Kenya forms the backbone of the country's agricultural sector, contributing significantly to the national economy, food security, rural employment and household livelihoods (Ministry of Agriculture and Livestock Development, 2024). In many agricultural counties, including Embu, small-scale farming remains a central pillar of local economies and a primary source of income for rural households. However, in recent years, the productivity and economic well-being of the small-scale farmers have increasingly been threatened by a wide range of agricultural risks, including unpredictable weather patterns, soil degradation, pests and disease outbreaks, fluctuating market prices, high farm input costs, shrinking land sizes, limited access to credit and agricultural extension services (Annappa, Bhavya, Kasturappa & Kumar, 2023). These risks have contributed to declining crop yields and reduced farm incomes, thereby undermining the

sustainability of rural livelihoods and exposing many farming households to poverty and food insecurity (Komarek, Pinto & Smith, 2020).

In Embu County, where the majority of household livelihoods depend heavily on agricultural production, these agricultural challenges have significantly reduced crop yields, thereby affecting income stability and household well-being. Although such challenges are widely acknowledged, there remains limited empirical understanding of how agricultural risks affect the livelihoods of small-scale farmers in the county and the extent to which they adopt effective adaptation strategies. Further, the sustainability of the strategies employed by these farmers in response to evolving climatic and socio-economic conditions remains insufficiently understood.

This study thus seeks to bridge this knowledge gap by examining the nature and impact of agricultural risks on small-scale farmers in Embu County and exploring the adaptation strategies they employ to sustain their livelihoods. The findings are expected to inform the development of targeted, evidence-based interventions and policies aimed at strengthening the resilience and long-term sustainability of small-scale farming in the region.

Research Objective

The main objective of this study is to assess the impact of agricultural risks on the livelihoods of small-scale farmers in Embu County, Kenya, and to explore the adaptation strategies they use to achieve sustainable household livelihoods.

Significance of the Study

This study is significant in several ways especially in the context of enhancing the resilience and sustainability of the small-scale farming in Embu County, Kenya. First, it is purposed to empower the Small-Scale Farmers as the findings are expected to assist the small-scale farmers better understand the agricultural risks they face in farming, also enlighten them on the range of adaptation strategies that exist for them, such knowledge is aimed at empowering them make informed decisions to not only improve their productivity but stabilize their incomes and overall resilience. The study also provides valuable insights for policymakers, development agencies and local governments which will guide formulation of targeted interventions and support mechanisms to address the specific needs of small-scale farmers in Kenya at large. Lastly the study will help towards Contributing to Academic Knowledge by adding to the existing body of literature on agricultural risk management and sustainable livelihoods, especially in the context of sub-Saharan Africa. It also serves as a reference point for future research on agricultural risks adaptations for the small-scale farmer's household sustainable livelihoods.

REVIEW OF RELEVANT LITERATURE

Farming is a risky venture in nature largely because it relies on risky factors of production such as land, water, biological processes, demand and supply and on top of all that it is heavily influenced by weather, all these factors are out of the farmer's control (Hameed, 2024). Farming requires effective risk management to mitigate the uncertainties and ensure its profitability (Solnosky, 2024). It is crucial for farmers to develop ways of managing agricultural risks for sustainability and profitability as it has direct impact on their livelihoods. Kahan (2013) and Kuang et al. (2020) listed a number of uncertainties that face agriculture that include extreme weather conditions, pest and diseases outbreaks, input price volatility, market fluctuations among others. According to Kumar et al. (2024) risks management in farming entails identifying and addressing potential risks such as unpredictable weather conditions, pest and disease outbreaks, market fluctuations and low

crop yields. In other words, famers and especially the small-scale farmers who rely on farming for their livelihoods must anticipate and plan for such types of risks, they must also come up with plans on how to reduce financial losses that come with agricultural production and at the same time identify sustainable agricultural practices that can help them respond timely to unforeseen circumstances, assist them to make informed decisions (Komarek, Alessandro, Smith, 2020). USDA (2025) recommends that to minimize the impact of agricultural risks, mitigate the impact of the uncertainties and ensure operational resilience, they add that the small -scale farmers must also employ a number of mitigation strategies that are crucial for sustainable farm incomes including; diversification of income streams, adopt technology, implement strong financial management and develop strong networks. Kumar et. al. (2024) highlights diversification as a crucial method of agricultural risks management, according to him, it involves strategies such as planting different types of crops, rearing multiple livestock and incorporating non-farm economic activities that assist the farmer to earn additional incomes, this style he says safeguards farmers against extreme outcomes whenever there are scenarios such as market downturns and certain crop failure as it ensures a multiple income source.

The uncertainties caused by weather calls for monitoring of weather forecasts, exploring drip irrigation as it does not rely on weather, on market and price fluctuation risks, there is also need for farmers to constantly update themselves on market trends. According to Being, Shahid and Starquadine (2019) and Maertens and Mey (2023) practicing crop diversification using varieties that withstand weather shocks like droughts resistant crops help spread the risks and give the farmer a chance to harvest something, having relationships with different clients is also crucial as it helps in comparing prices, it's also never too early to start looking for futures markets, practicing good farm hygiene such as weeding and having terraces to drain rain water helps and cannot be over emphasized. On pest and disease outbreaks, small scale farmers must invest in varieties of crop that are disease-resistant crops, regular monitoring of crops as they grow also ensures early detection for timely response so as to minimize the impact of disease and pest outbreaks (Barooah et al., 2017; Kalele, Ogara, Oludhe, Onono, 2021). Regarding financial risks such as inflation and irregular currency exchange rates, high cost of farm in inputs, high production costs and low market demand, all of which impacts farm incomes, financial planning is important, also Proper budgeting and risk forecasting is necessary to help farmers deliberate and plan for these kinds of risks effectively (Klapper, Singer, Ansar & Hess, 2019).

In addition to all these risk management strategies, the US department of agriculture (USDA) recommends a number of practices that need to be implemented by farmers that include; adopting good record keeping and accurate records for all their farm financial transactions in order to monitor profitability or loses and make good and informed decisions, organizing themselves and having emergency and a reserve fund to manage their debts, avoiding excessive borrowing and maintain a healthy credit score. They added that small-scale farmers also need to adopt sustainable farming practices that advance resilience such as improving the health of soil, conserving moisture around the crops and reducing overreliance of external inputs, have efficient water use like rainwater harvesting for conservation. They also advocate for farmers forming strong bonds with suppliers so as to develop reliable partnerships with suppliers for consistency in accessing quality inputs and finally, the emphasis on the need for mentorship programs with fellow farmers and forums of networking and also connecting with industry experts so as to share valuable knowledge and resources. Farmers developing proactive risk measures for managing the risks so as to achieve profitability and sustainable livelihoods is crucial as well.

It is clear that the agriculture industry is quite a complex one, faced by a cocktail of risks at every stage of production; beginning at the planting stage, to the growing phase, harvesting stage, all the way to the storage and marketing phase. The need therefore to identify and understand the various risks involved is crucial so that farmers can develop mitigation strategies to minimize the impact of all the risks involved at every stage and shield their livelihoods (Wantasen, Rintjap, 2020). Farmers who effectively manage and subdue agricultural risks leap far reaching benefits, as outlined by Salman (2023), rural small-scale farmers who secure sustainable livelihoods, are able to meet their basic needs, provide quality education for their children, able to afford good healthcare for their families, make good investment for themselves and secure a bright future for their children. Sustainable rural development is initiated and it brings vibrancy and prosperity for rural communities which is essential for sustainable development (Habib, 2024; Kumar et al. 2024). By improving the small-scale farmers livelihoods therefore, rural economies thrive and create employment, minimize rural-urban migration and help preserve cultural heritage as well as conserve the environment (Ndlela, Worth, 2021). In short, small-scale farmers who navigate agricultural mitigation leap huge benefits of not only achieving sustainable livelihoods but securing bright future for their children.

Theoretical Analysis

This study employed the Sustainable Livelihoods Framework (SLF) to guide the analysis of household livelihood strategies and outcomes.

Sustainable Livelihoods Framework (SLF)

This study adopts the Sustainable Livelihoods Framework (SLF), originally developed by Robert Chambers in the mid-1980s to address rural poverty and improve development effectiveness (Vornholz, 1994; Serrat, 2017). The framework provides a holistic, people-centered approach for understanding how vulnerable households manage assets, cope with risks and navigate institutional contexts to shape their livelihood opportunities (Morse, McNamara, & Acholo, 2009). The framework has been widely applied and further developed by scholars such as Morse and McNamara (2013), Holland et al. (1998) and Habib (2024) who integrate socio-economic, institutional and environmental dimensions to explain livelihood strategies, vulnerability and resilience. It has however been criticized for its limitations to addressing institutional capacity, power relations and policy constraints but as Morse (2025) asserts, the framework still remains a valuable tool for analyzing rural livelihoods due to its comprehensive and people-centered nature.

The framework is highly relevant to this study as it offers a comprehensive approach for analyzing how small-scale farmers in Embu and other parts of Kenya respond to agricultural risks. By examining the interaction between household assets, risks and institutional support, it identifies key constraints and adaptation strategies that enhance resilience, stabilize incomes and improve food security. Its application also enables the study to generate evidence-based insights for policies and interventions that strengthen the sustainability of small-scale farming.

RESEARCH METHODOLOGY

This study adopts a mixed-methods research design that integrates both quantitative and qualitative approaches to comprehensively examine the impact of agricultural risks on the livelihoods of small-scale farmers and the adaptation strategies employed in an effort to achieve sustainable livelihoods. According to Kalpokas and Radivojevic (2022) the mixed method approach provides a more comprehensive understanding of a research problem, enabling the researcher to explore patterns

while capturing, behaviors, experiences and motivations behind them. Since agricultural risk and livelihood sustainability are a multidimensional phenomenon, this study chose the mixed-methods approach so as to make use of both statistical measurement and contextual understanding. While the quantitative component enabled the assessment of the magnitude and determinants of risk exposure and livelihood outcomes, the qualitative component provided deeper insights into farmers' perceptions, coping mechanisms, and institutional challenges. The integration of both approaches enhances the validity, reliability, and depth of the findings.

Target Population

The target population for this study comprised of the small-scale farmer's households in upper Embu County which is made of Manyatta and Runyenjes constituencies. The four constituencies that make up Embu County consist of Manyatta, Runyenjes, Mbeere North, and Mbeere South. However, the study focused on Manyatta and Runyenjes constituencies due to their relatively homogeneous agro-ecological and socio-economic characteristics. Mbeere North and Mbeere South constituencies are characterized by comparatively drier climatic conditions and distinct livelihood systems which differ from those of the selected constituencies. Small-scale farmers in Manyatta and Runyenjes primarily depend on agriculture for their livelihoods, making them appropriate for examining the impact of agricultural risks on sustainable livelihoods. The study also included key informants, specifically, agricultural officers and senior farmers to provide institutional perspectives on agricultural risk management and adaptation strategies.

Data Collection Instruments and Data Analysis

The study utilized questionnaires and interview schedules as the primary data collection instruments. These instruments generated both qualitative and quantitative data. Quantitative data were analyzed using descriptive statistics, including means, percentages, frequencies, and standard deviations, as well as inferential statistics, specifically Ordinary Least Squares (OLS) regression. Descriptive statistics were used to summarize the characteristics of the sample population and to present the data in a simplified and understandable form (Gravetter & Wallnau, 2014). The analyzed data were presented in tables. Qualitative data obtained from interviews were analyzed thematically to complement the quantitative findings.

The qualitative data collected from the interviews schedules was coded and data with similar patterns and meaning was classified into themes. The responses were categorized as recurring themes and patterns and were presented in narrative forms. This information enabled insights for the study objective.

Sampling techniques and sample size

The study used a multi-stage sampling approach to select respondents from the target population of small-scale farmers in Upper Embu. Purposive sampling was first applied to select sub-counties, including the constituencies of Manyatta and Runyenjes which are predominantly engaged in small-scale farming and share similar agro-ecological and socio-economic characteristics. Stratified sampling was applied based on the highland and midland zones to capture differences in farming practices and exposure to agricultural risks. Households were selected using simple random sampling, where every household had an equal chance of being chosen by assigning numbers to all households and randomly picking from them, resulting in a total of 118 households across the two constituencies. 118 respondents provided sufficient representation for reliable quantitative and qualitative analysis. This sample size allowed for meaningful statistical inference

using descriptive statistics and Ordinary Least Squares (OLS) regression. Data were collected through questionnaires and interview schedules, while key informants were 10, they included agricultural officers and senior farmers, they provided qualitative insights. Interview data were coded, grouped into themes, and presented narratively to complement the quantitative findings.

Sample Size Determination

According to Kenya's most recent Population and Housing Census conducted in 2019, the combined population of Manyatta and Runyenjes sub-counties was approximately 297,000 people living in the non-urban areas of the two constituencies (Kenya National Bureau of Statistics, 2020). Based on national agricultural participation patterns, it is estimated that about 40 percent of this population, approximately 118,800 individuals, engage in small-scale farming within the two constituencies. Given the large size of this estimated farming population, it is neither practical nor necessary to survey all farmers. To come up with a representative sample, the researcher was guided by Mugenda and Mugenda (2003) who recommend the application of the 10 percent research rule, in which a researcher selects about ten percent of the target population to obtain a representative sample. In this study, 10 percent of the estimated farming population yielded approximately 118 respondents, which were considered adequate for generating reliable quantitative data for descriptive statistics and Ordinary Least Squares regression analysis. In addition, qualitative insights were obtained from purposively selected ten key informants. This approach ensured that the findings can reasonably be generalized to the broader small-scale farming population within the study area.

For the qualitative data, 10 key informants were purposively selected, with 5 from Manyatta and 5 from Runyenjes Constituencies. Each constituency comprised 2 agricultural officers and 3 senior farmers, chosen for their expertise and experience in small-scale farming. The interview data were coded, categorized into themes, and presented narratively to complement the quantitative survey findings.

RESULTS AND DISCUSSION

This section presents and discusses the demographic characteristics of the respondents involved in the study.

Demographic Characteristics of Respondents

The study sought to identify the major agricultural risks affecting small-scale farmers, their impact and adaptation strategies for sustainable livelihoods in Embu County. A total of 118 farmers participated in the survey, of whom 60% were female. The majority of respondents were aged between 35 and 65 years and approximately 75% had attained primary or secondary level education, with an average farm size of about 1.5 acres.

The participants were asked to indicate the extent to which they believed various agricultural risks affected their farming activities and the results of the analysis were presented in Table 4.1

Major Agricultural Risks	Percentage of respondents affected in (%)
Unpredictable rainfall	85%
Fluctuating Market prices	65%
Disease and pest outbreaks	78%
Limited access to credit	55%
Soil degradation	40%

Source: Survey data, 2026

As shown on table 4.1 The results of the analysis reveal that unpredictable rainfall patterns were the most significant risk (85%), followed by pest and disease outbreaks (78%), fluctuating market prices (65%), limited access to credit and inputs (55%), and soil degradation (40%). These findings underscore the dominance of climate-related risks and their implications for crop productivity and income stability among small-scale farmers.

Impact of Agricultural Risks on Livelihoods

The participants were asked to indicate the extent to which they believed agricultural risks affected their farming activities and livelihoods, the results of the analysis are presented in Table 4.2.

Impact of Agricultural risks on livelihoods	Percentage of respondents (%)
Reduced crop yields	82 %
Income loss	76%
Food insecurity	60%
Increase reliant on off farm incomes	35%

Source: Survey data, 2026

As shown in table 4.2 the results of the analysis show that the most significant impacts of agricultural risks on farming activities and livelihoods included reduced crop yields (82%), income loss (76%), food insecurity (60%), and increased reliance on off-farm income sources (35%). These results highlight the high level of vulnerability among small-scale farmers, as declines in crop production and income directly undermine household food security. Consequently, many households are compelled to diversify into off-farm income-generating activities, which act as a coping mechanism and not always sustainable in the long run.

Perceived Effectiveness of Adaptation Strategies

The participants were asked to indicate the extent to which they perceived various adaptation strategies to be effective in addressing agricultural risks, and the results of the analysis are presented in Table 4.3.

Adaptation Strategy	Perceived effectiveness	Sustainability	Barrier Identified
Off-farm income strategies	Highly effective	High	Limited capitals to start off-farm economic activity
Crop diversification	Highly effective	High	Requires knowledge of suitable crops
Use of improved crop varieties	Highly effective	moderate	Access to quality seeds and technical support
Irrigation	Effective	Low	High initial installation costs
Cooperatives	Improved market access	Moderate	Limited reach and membership

Source: Survey data, 2026

The findings indicate that off-farm income diversification and crop diversification were perceived as the most effective and sustainable adaptation strategies. The use of improved crop varieties was also reported to be highly effective in enhancing resilience to agricultural risks. Irrigation was considered effective; however, its adoption was constrained by high initial investment costs. Similarly, participation in cooperatives was found to improve market access, although its impact was limited by restricted coverage and accessibility.

These results suggest that while farmers are actively adopting a range of adaptation strategies, sustainable resilience requires a combination of individual initiatives and stronger institutional

support. In particular, long-term adaptation is likely to depend on integrated approaches involving government agencies, non-governmental organizations, and private sector actors.

Additionally, key informants were used to provide qualitative insights that complemented the quantitative findings. The key informant participants were asked about their experiences with climate, markets as well as farming strategies, and the responses were coded into key themes. Below are some of the responses from the key informants:

“Nowadays the rains have become very unpredictable; some seasons we get too much rain that cause floods which end up destroying our crops, other seasons the rains are too little, the crops dry before they can even flower, and it really affects farmers.”

Another key informant said:

“Selling our farm produce is not always easy, sometimes the prices drop suddenly, and we have no choice but to sell at a loss.”

Yet another one said:

“The farmers try different crops and also some try their hand in small businesses outside the farm which help their families survive especially during tough seasons.”

These findings reveal that climate variability and market constraints are major risks affecting farmers’ livelihoods, while adaptation strategies such as crop diversification, use of improved crop varieties and engagement in off-farm income activities were identified as critical for enhancing resilience. Overall, the qualitative results support the quantitative findings, indicating that effective adaptation depends on both individual efforts and institutional support systems.

CONCLUSION AND RECOMMENDATIONS

This section presents the conclusions drawn from the study findings and provides recommendations based on the key issues identified.

Conclusion

This study examined the impact of agricultural risks on small-scale farmers in Embu County, Kenya, and their adaptation strategies. Farmers face multiple risks, including climate variability, pest and disease outbreaks, fluctuating market prices and limited access to inputs and credit, which affect yields, income and food security. Despite these challenges, farmers adopt strategies such as off-farm activities, crop diversification, improved varieties, soil conservation and irrigation. Overall, sustainable livelihoods and resilience depend on both individual farmers’ efforts and strengthened support from government and private sector actors through access to resources, training, and markets.

Recommendations

Based on the findings, the following recommendations are proposed:

1. **Improve Access to Inputs and Credit:** Facilitate smallholder farmers’ access to affordable agricultural inputs (e.g., drought-resistant seeds, fertilizers) and tailored credit facilities to enhance productivity and support risk management.

2. *Invest in Water Management and Irrigation:* Develop small-scale irrigation systems and water harvesting technologies to reduce dependence on rainfall and improve climate resilience.
3. *Strengthen Policy Support and Stakeholder Coordination:* Integrate agricultural risk management into county development plans and ensure effective coordination among government agencies, County governments, and the private sector.
4. *Enhance Capacity through Training and Technical Support:* Provide continuous training on sustainable farming practices, adaptation strategies and risk management to empower farmers to effectively cope with agricultural risks.

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