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Analysing the Coping Strategies of Climate Change by Small Scale Maize Farmers: A Case Study of Kafue District in Zambia

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Abstract

For the past few years, Zambia, like many other countries, has been facing the harsh effects of climate change. This has led to poor agricultural productivity/yields for many small-scale farmers, leading to unstable food prices and food insecurity in the country. This research analyzes the coping strategies of climate change by small scale maize farmers. The research was addressed by the following objectives; To establish coping strategies by small scale maize farmers; To examine the effectiveness of coping strategies used by small scale maize farmers; To assess how farmers adapt to climate change. A sample size of 50 respondents was selected from various maize farmers of Kafue district to help provide data. The research study used both qualitative and quantitative methods, surveys and focus group discussions. The key findings highlighted a diverse range of challenges faced by most small-scale maize farmers, including poor agricultural productivity/yields due to climate change, lack of financial support to effectively implement climate change coping strategies, and poor investment and saving patterns due to poor yields. 31.25% of the respondents said increased frequency and intensity of droughts reduce maize yields, 38.75% said unpredictable rainfall patterns lead to planting and harvest challenges, and 30% said that pests and diseases are more prevalent due to changing climates. Despite these challenges, some respondents expressed satisfaction in their agricultural activities due to some coping strategies they implemented to try and reduce the impact of climate change on their agricultural productivity. This study shows the various coping mechanisms employed by farmers such as the growing of climate resilient crops, investments patterns and saving patterns, and irrigation practices. The preliminary findings suggested that there is a significant negative relationship between agricultural productivity and climate change. Therefore, farmers are encouraged to implement various climate change coping strategies in order to improve their agricultural productivity. These findings hold crucial implications for policymakers, highlighting the importance of targeted interventions to enhance agricultural productivity despite harsh climate change conditions as a means to improve household wellbeing and promote sustainable development in the country.

Keywords: Climate Change, Small Scale Farmers, Coping Strategies

1. Introduction

Agriculture still remains one of the most important activities in a country globally. Despite other countries being well developed like the United States, they still need agricultural productivity as their source of food and other raw materials. World Bank reports that 2.5 billion people depend on agriculture as their main source of livelihood and among them 1.3 billion people are small farmers and landless workers (ECG, 2015). Therefore, improved agricultural productivity is very important so as to help improve the living conditions of many people whose livelihoods greatly depend on agriculture. Agriculture is dependent on a wide range of ecosystem processes that support productivity including maintenance of soil quality and regulation of water quality and quantity. Multiple stressors, including climate change, increasingly compromise the ability of ecosystems to provide these services. Increases of atmospheric carbon dioxide, rising temperatures, and altered precipitation patterns affect agricultural productivity (Walthall *et al*, 2016).

According to Tembo and Sitko (2015), Zambia, like much of the Southern African region, remains vulnerable to unstable food prices and food insecurity despite competitive advantages such as abundant agricultural land. Agriculture plays a key role of supporting agro-based industries by the production of the required raw materials, producing exportable agricultural goods, generating employment particularly in rural areas (approximately 70 percent of the population derives its livelihood from agriculture), as well as providing food essential for the sustenance of acceptable nutrition standards and levels, and improves the general economy (Darku *et al* 2019). The agricultural sector in Zambia is currently facing severe challenge due to climate change. Effects such as poor rainfall, drought, floods, etc. have affected the agricultural productivity in Zambia resulting in high food prices, food security challenges, poor nutritional levels and many others (Ibid).

Several policies have been put in place to raise the agricultural productivity and create climate change resilience, adaptation and coping strategies for farmers especially small-scale farmers. Policies and interventions such as the National Climate Change Policy aimed at stemming the impact of climate change and subsequent reduction of the country's annual economic growth due to crop failure and the impact of climate change on energy production (Deka *et al*, 2016), the government of Zambia has over the years has implemented some measures to address the adverse impacts to ensure that the country attains climate resilience and enhance its adaptation actions, measures such as the development of the National Adaptation Programme of Action (NAPA), the National Climate Change Response Strategy (NCCRS) and more (GRZ, 2023). Kafue district is a district located in Lusaka province of Zambia. It covers a total surface area of 6,500 sq.km and is known for its agricultural activities with both small-scale farming families and commercial farmers. This study will, therefore, target the small-scale maize farmers of Kafue district.

1.1 General Objective

The general objective of this study is to analyze the coping strategies of climate change by small scale maize farmers in Kafue District.

1.1.1 Specific Objectives

1. To identify the types of coping strategies of climate change by small scale maize farmers.
2. To examine the effectiveness of coping strategies used by small scale maize farmers.
3. To assess the limitations of farmers in adapting to climate change.

1.2 Theoretical Framework

According to Joonas *et al*, (2020) [20], several studies assessed the impact of climate change on agriculture, especially the impact on crop production. These studies used different models and approaches to assess, measure, and simulate the impact of climate change on agriculture. The Food and Agriculture Organization FAO (1996) developed the crop suitability approach, which is also referred to as the Agro-Ecological Zoning (AEZ) approach, in which the suitability of various land and biophysical attributes to crop production was assessed. The approach used crop characteristics, existing technology, and soil and climate factors to determine the suitability of crop production to various areas. Researchers du Toit *et al* (2001) and Xiao *et al* (2002) also used the AEZ model to predict the impact of changing variables on potential agricultural output and cropping patterns by including climate as a major determinant of the suitability of agricultural land to crop production. However, Mendelsohn and Tiwari (2000) emphasized one disadvantage of the AEZ methodology in that it is not possible to predict the final outcomes without explicitly modeling all relevant components. The omission of one major factor, such as existing technology or soil factors, could substantially affect the model's predictions.

The AEZ framework is grounded in the concept of assessing land suitability for agriculture based on climatic, soil, and topographical characteristics (FAO, 1996). Its relevance to this study stems from its ability to identify agro-ecological constraints in maize farming under changing climate regimes, to map regions where adaptation strategies are most urgently needed or have the highest impact, and to provide a spatial understanding of how ecological conditions influence adaptive practices such as shifting planting dates or adopting drought-tolerant maize varieties (du Toit *et al*., 2001; Xiao *et al*., 2002).

By applying the AEZ model, the study can assess how ecological conditions shape or limit the coping strategies employed by smallholder maize farmers. For instance, farmers in areas classified by AEZ as low-rainfall regions might favor early-maturing maize varieties or conservation agriculture as coping strategies.

The production function approach incorporates environmental variables such as temperature, rainfall, and CO_2 concentration into yield estimation (Mendelsohn *et al*., 1994). This can help quantify how changes in climate variables affect maize output at the household level, identify thresholds beyond which adaptation strategies fail or succeed, and allow researchers to simulate potential productivity gains from specific coping strategies like irrigation, soil conservation, or use of improved seed.

By modeling yield changes as a function of both climatic variables and coping interventions, this approach links climate stressor with adaptation responses and their impacts on maize production.

2. Literature Review

2.1 Types of coping strategies to climate change used by small scale maize farmers

Climate change presents a severe threat to agricultural productivity and rural livelihoods, particularly among small-scale farmers in Zambia who predominantly depend on rain-fed agriculture. Prolonged droughts, erratic rainfall patterns, and rising temperatures have contributed to declining crop yields and food insecurity (Mulenga *et al*., 2017) [24]. In response, Zambian smallholder farmers have adopted a range of coping strategies to mitigate the effects of climate change. Conservation Agriculture has been widely promoted in Zambia as a sustainable land management practice aimed at increasing productivity and resilience. It involves minimal soil disturbance, crop rotation, and residue retention, which together improve soil structure and water retention capacity. According to Haggblade and Tembo (2013) [16], conservation agriculture has been adopted by over 200,000 farmers in Zambia, primarily through donor-supported programs such as the Conservation Farming Unit (CFU). In a study conducted in Eastern Province, farmers practicing conservation agriculture reported yield increases of up to 60% during periods of low rainfall, compared to those using conventional methods (Nyanga, 2012) [28]. However, uptake is hindered by labor intensity and limited access to inputs like herbicides (Thierfelder *et al*., 2015) [32].

Agroforestry, the integration of trees and crops, serves as a climate adaptation strategy that enhances soil fertility, biodiversity, and moisture conservation. Farmers in Southern and Eastern Provinces have adopted Faidherbia albida trees, which enrich soils and improve maize yields. A study in Chipata District revealed that households using agroforestry reported more stable yields and reduced vulnerability to drought (Ajayi *et al*., 2011). Furthermore, traditional knowledge systems, such as planting drought-tolerant local varieties and altering planting calendars based on local indicators, remain essential in areas where extension services are lacking (Mubanga, 2019) [23].

Another strategy employed by small-scale farmers is diversification of livelihoods and crops. Diversification is a common coping strategy among Zambian smallholders. Farmers diversify both within agriculture (e.g., multiple crops) and outside of it (e.g., petty trading, charcoal burning) to reduce risk exposure. In Monze District, Chinsembu and Chanda (2018) observed that households growing a mix of maize, cassava, and groundnuts were more food secure than mono-cropping households during drought years. Similarly, in Northern Zambia, households engaged in off-farm income-generating activities were better equipped to purchase food when crops failed (Sitko and Jayne, 2014). However, income diversification opportunities are often constrained by poor infrastructure and limited market access.

The Zambian government, through its Climate Change Response Strategy and the National Agricultural Policy, has partnered with international agencies to scale up adaptation support. Programs such as the Farmer Input Support Programme (FISP) and the Weather Index Insurance Scheme provide inputs and risk protection. For example, the World Food Programme piloted weather index insurance for smallholders in Mazabuka and Mongu Districts. Participating farmers received payouts following drought events, helping them recover faster and invest in the next planting season (WFP, 2020) [35]. However, insurance uptake remains low due to lack of awareness and trust.

The promotion of drought-tolerant seed varieties, especially early-maturing maize, is a key strategy. Farmers in Central and Southern Zambia have widely adopted varieties like SC403 and ZM521, which mature earlier and require less water (Langyintuo *et al*., 2008). A study in Kalomo District found that farmers planting early-maturing maize experienced a 40% reduction in crop failure compared to those using traditional seeds during the 2018–2019 drought (ZARI, 2019) [38]. Community seed banks have also emerged to preserve local varieties and ensure access to quality seed during crises.

2.2 Effectiveness of the coping strategies used by small scale maize farmers

In Zambia, small-scale farmers form the backbone of the agricultural sector, contributing approximately 80% of the country's food production (Zulu-Mbata *et al*., 2020). However, increasing climate variability characterized by droughts, floods, and shifting rainfall patterns has undermined agricultural productivity, food security, and rural livelihoods. In response, smallholder farmers have adopted various coping strategies. These include crop diversification, conservation agriculture, the use of drought-tolerant seed varieties, livelihood diversification, and reliance on indigenous knowledge. Below is an evaluation of the effectiveness of these strategies.

Crop diversification and mixed farming: Crop diversification has been moderately effective in enhancing food security by reducing the risk of total crop failure. Farmers grow different crops such as sorghum, millet, cassava, and legumes alongside maize, which helps maintain household food availability even during droughts. A study in Southern Province found that farmers who grew drought-tolerant crops like cowpeas and groundnuts alongside maize had better harvest outcomes during the 2015/16 El Niño-induced drought (Ngoma, 2018). These households reported lower food deficits and greater resilience. This strategy may be limited in it's effectiveness as market access for non-maize crops remains weak, reducing the economic benefits of diversification.

Conservation Agriculture (CA): Conservation agriculture, entailing minimum tillage, crop rotation, and soil cover, has shown promise in improving soil moisture retention, reducing erosion, and increasing yields in drought-prone areas. Farmers in Eastern Province under the Conservation Farming Unit (CFU) program reported yield increases of 30–50% compared to conventional tillage systems during dry seasons (CFU, 2017) [4]. Conservation Agriculture practices helped maintain productivity and reduced reliance on external inputs. Labour demands and knowledge requirements have slowed the adoption of this strategy, particularly among poorer households.

Use of drought-tolerant and early-maturing seed varieties: Adopting improved maize and legume seed varieties that mature early or tolerate dry conditions has enabled farmers to mitigate the effects of erratic rainfall and shorter growing seasons. In Central Province, the introduction of early-maturing maize varieties like SC403 and drought-tolerant varieties like ZM521 under the Ministry of Agriculture's Farmer Input Support Programme (FISP) led to higher yields and greater food availability among participating households (Sitko *et al*., 2019) [29]. Despite this, the effectiveness of this strategy is limited because access to quality seed is inconsistent, and many farmers continue to rely on recycled seed due to affordability issues.

Livelihood diversification and off-Farm income has as well proven to be an effective way of coping to climate change. Engaging in non-farm activities such as petty trade, charcoal production, and seasonal labor provides an important income buffer during periods of agricultural failure. In Western Province, farmers affected by seasonal floods and dry spells reported engaging in fishing and small businesses to sustain household income (Tembo *et al*., 2020). These alternative livelihoods helped maintain food access and reduced dependence on erratic crop performance. However, not all households can access alternative income opportunities due to lack of skills, capital, or local economic opportunities.

2.3 Limitations of small-scale farmers in adapting to climate change

Most Zambian smallholders depend on seasonal rainfall; irrigation coverage is very low. This makes households highly sensitive to seasonal rainfall failure and droughts, which have caused major crop losses and even national food shortfalls in recent years. Limited on-farm water storage, weak small-scale irrigation systems, and competition for water (including reduced hydropower affecting fuel and transport) constrain practical adaptation choices such as crop. Adoption of climate-smart practices (conservation agriculture, drought-tolerant seed, water harvesting, solar pumps) requires up-front capital that many smallholders lack (UNFCCC, 2023). Credit markets are thin for very small farms; collateral requirements, high interest rates, or lack of tailored micro-finance products mean many farmers cannot afford resilience investments. Studies and FAO/World Bank assessments show that high initial costs and limited access to affordable finance are primary adoption barriers.

Extension coverage in many rural districts is limited; available advisory services are often not localized to farmers' microclimates or cropping systems. Seasonal forecasts, early-warning systems, pest/disease alerts, and practical training on conservation agriculture or integrated pest management are often not reaching smallholders at scale. This reduces farmers' ability to make timely adaptation decisions. Several FAO and national reports stress the need for scaled, behaviourally-informed extension to increase uptake. Even when farmers can increase production or diversify, poor rural roads, lack of storage/processing facilities, and weak market linkages limit their ability to realize higher incomes from adaptation (FAO, 2021). Post-harvest losses (due to lack of drying, storage) and limited access to value chains make adaptation investments less remunerative and riskier for smallholders. Zambia's climate finance needs are large relative to available domestic resources; donors and multilateral funds exist but accessing them requires strong institutional capacity and co-financing. The national adaptation planning documents note gaps in coordination among ministries, limited sub-national capacity, and difficulties channeling finance to community and smallholder levels—so many small projects remain pilot-scale rather than scaled (World Bank, 2020).

Low literacy/education levels, limited access to formal training, and gendered barriers (women's reduced access to land, credit, extension) restrict some households' capacity to adopt complex or capital-intensive adaptation practices. Vulnerable groups, women, the elderly, persons with disabilities, are often less reached by programs, reducing household and community resilience. Program evaluations and UN/NGO reports emphasize the need for inclusive targeting. Even where technologies exist (e.g., conservation agriculture, improved seedlings), adoption may be low because practices conflict with local beliefs, require changes in labor timing or social organization, or produce benefits that are seen as long-term rather than immediate. Behavioural factors and local perceptions therefore matter; recent projects have begun using behavioural science to improve uptake (The Guardian, 2024). Frequent acute shocks, severe droughts (e.g., 2023–2024 national drought), episodic floods, and pest outbreaks, can rapidly erase household savings and damage assets, pushing households into coping rather than adaptation. News reporting and national project monitoring show how shocks undermine incremental resilience building. Rural broadband, mobile connectivity, and electrification gaps limit the reach of digital advisory services (index insurance delivered by mobile, weather alerts, market price information), as well as the operation of solar pumps or small processing units. The African Development Bank and World Bank country profiles call this a binding constraint to scaling climate-smart innovations (Parliamentary Committee on Agriculture, 2023).

These limitations act together: lack of finance and irrigation makes farmers vulnerable to drought; weak extension and localized forecasts reduce timely decisions; poor markets and storage make investments uneconomic; institutional and tenure issues limit sustainability of improvements; and acute shocks can wipe out savings (Chavula, 2022). To increase adaptive capacity for Zambian smallholders, the literature and national plans point to a package approach: expand small-scale irrigation and water harvesting, scale inclusive micro-finance and tailored insurance, strengthen localized extension (behaviourally-informed), invest in rural roads and storage, improve coordination of climate finance to reach community level, and integrate gender-sensitive targeting. The Zambia NAP, UNDP/Green Climate Fund projects, FAO guidance and recent analytical reports all support these multi-pronged interventions (UNDP, 2023).

2.4 Literature gap

A gap exists in evaluating the effectiveness of institutional mechanisms in improving resilience among Kafue's small-scale maize farmers. There is a need for in-depth impact evaluations of government and donor-supported adaptation programs, focusing on their efficiency, accessibility, and scalability, especially for marginalized groups. There is a lack of studies on the integration of mitigation and adaptation in smallholder systems, particularly how climate-smart agriculture contributes to national and global mitigation goals. Many studies mention adaptation strategies but do not sufficiently explore why some farmers adopt certain practices while others do not, despite exposure to similar risks and interventions. For example, despite the availability of early-maturing maize, uptake varies (ZARI, 2019) [38], and reasons such as cultural preferences, market incentives, or knowledge gaps are not examined in detail. Research is needed to understand socio-economic, cultural, and institutional barriers to adoption of adaptation strategies and what incentives (e.g., subsidies, training, market access) are most effective.

3. Research Methods

The research design to be used in this study is the case study design. This design is suitable because it often helps to narrow down a very broad field of research into one or a few easily researchable examples (Bryman, 2012). The researcher adopts this design because the study involves the in-depth collection of data to accurately and objectively describe the existing phenomena, making it suitable for the study (Creswell, 2012).

3.1 Target Population

The target population for this study are the small-scale maize farmers in Kafue ward of Kafue district. Kafue district has approximately 10,000 small scale maize farmers (Lusaka times, 2015).

3.2 Sampling Design

For the sampling design, this research study will implement and utilize purposive sampling design (Creswell (2015). Purposive sampling is suitable for the selection of participants that are willing to reflect on and share the knowledge relating to the study. Purposive sampling is appropriate because it is known to be representative of the total population, and it produces well-matched groups Kristjanson *et al* (2003).

3.3 Sample Size Determination

Best and Kahn (2008) referred a sample size to as a small segment of the population that is selected for observation analysis. A sample size of 10% of a studied population is sufficient enough to generate valid results. Therefore, the sample size of this study is 50 respondents.

3.4 Data Collection Methods

This study will use a mixed method research approach that aims at collecting both qualitative and quantitative data from the participants. Therefore, the data collection methods to be used in this study is structured surveys or questionnaires and focus group discussions (Christensen (2015). This will help the researcher gain a comprehensive understanding of the coping strategies of climate change by small scale farmers, while capturing both qualitative and quantitative data. This method helps to gather the statistical information and also delve into the lived experiences and nuances of the coping strategies of climate change by small scale farmers.

3.5 Data Analysis

The data analysis tools to be used in this study are data visualization tools such as Microsoft Excel, and the statistical Software such as STATA to help analyze survey data.

4. Findings and Results

4.1 Background characteristics of the respondents

Table 4.1.1: Sex of respondents

Sex of Respondents	Frequency	Percent
Male	25	50%
Female	25	50%
Total	50	100%

Source: Primary Data 2025

The table above shows the gender of the respondents which constitutes of 50% male and 50% female respondents.

Table 4.1.2: Age of the respondents

Age	Mean	Std. Dev.	Min	Max
	47.1375	11.54819	28	70

Source: Primary Data 2025

The age distribution of the respondents was that the average age was 47.1375 with a standard deviation of 11.54819, the youngest respondent was 28 years of age and the oldest was 70 years of age.

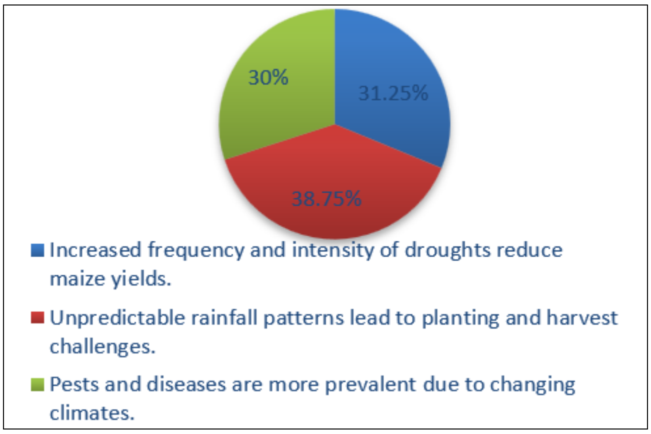
Table 4.1.3: Highest level of education of the respondents

Highest level of education	Frequency	Percent
Secondary School	10	21.25%
Diploma	14	27.50%
Bachelors' Degree	14	27.50%
Masters' Degree	8	16.25%
PhD	4	7.50%
Total	50	100%

Source: Primary Data 2025

The table above shows the different levels of education of the respondents, 21.25% of which hold Secondary School Certificates, 27.50% hold Diplomas, another 27.50% hold Bachelors' Degree, 16.25% hold Masters' Degrees, and 7.50% hold PhDs.

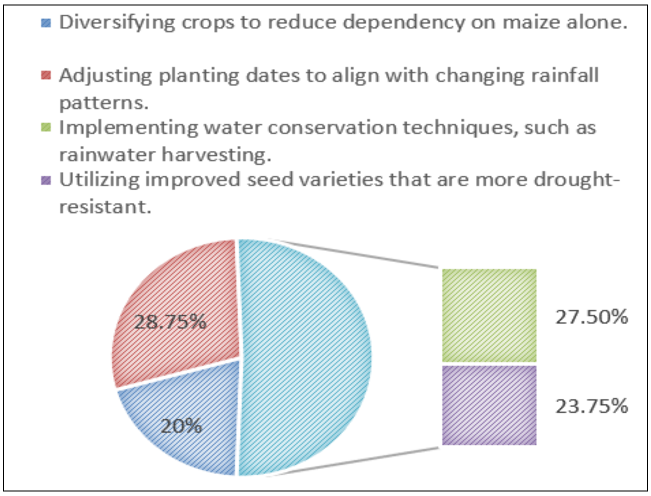
4.2 Types of coping strategies to climate change used by small scale maize farmers



Source: Primary Data 2025

Fig 4.2.1: Specific climate change impacts small-scale maize farmers are experiencing in this region

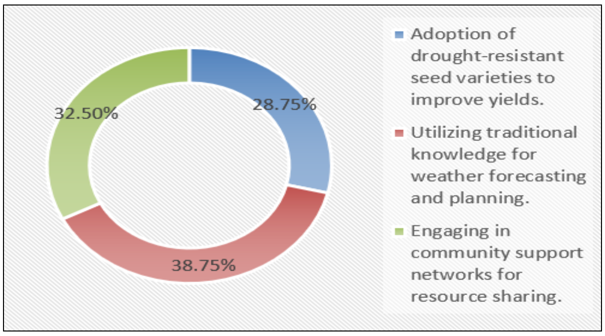
The figure above gives the response of what specific climate change impacts small-scale maize farmers are experiencing in this region. 31.25% said increased frequency and intensity of droughts reduce maize yields, 38.75% said unpredictable rainfall patterns lead to planting and harvest challenges, and 30% said that pests and diseases are more prevalent due to changing climates.



Source: Primary Data 2025

Fig 4.2.2: How small-scale maize farmers adapt their farming practices in response to changing climatic conditions

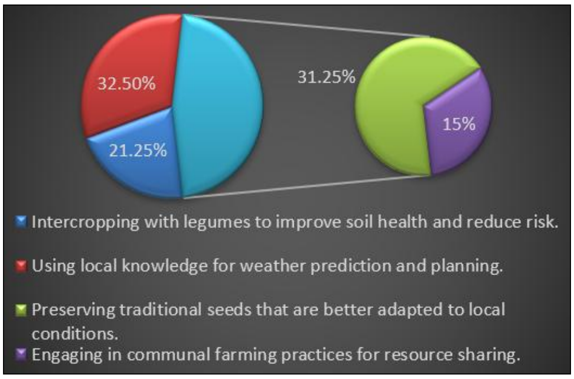
The chart above shows the farmers' responses on how they adapt their farming practices in response to changing climatic conditions. 20% adapted by diversifying crops to reduce dependency on maize alone, 28.75% adjusted their planting dates to align with changing rainfall patterns, 27.50% implemented water conservation techniques, such as rainwater harvesting, and 23.75% utilized improved seed varieties that are more drought-resistant.



Source: Primary Data 2025

Fig 4.2.3: Coping strategies small-scale maize farmers currently use to manage climate-related challenges

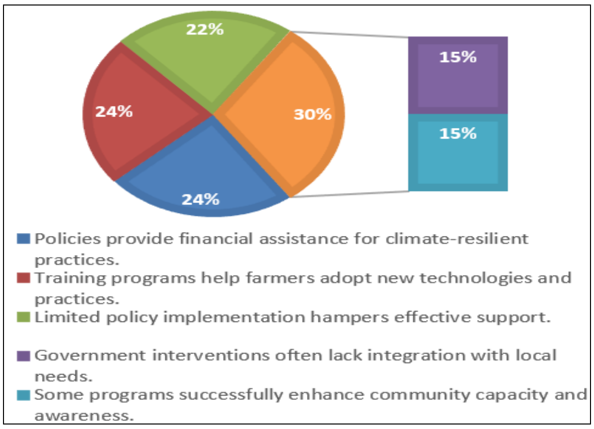
Above is the response of the farmers on the coping strategies they currently use to manage climate-related challenges. 28.75% adopted drought-resistant seed varieties to improve yields, 38.75% utilized traditional knowledge for weather forecasting and planning, while 32.50% engaged in community support networks for resource sharing.



Source: Primary Data 2025

Fig 4.2.4: Traditional coping strategies small-scale maize farmers employ to manage climate-related challenges

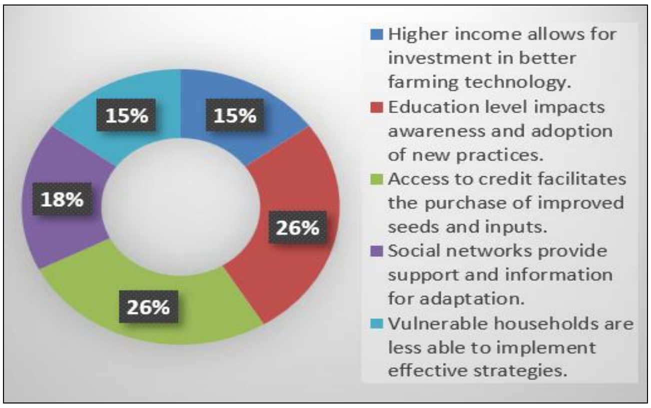
The pie chart above is an illustration of the response of the farmers on the traditional coping strategies they employ to manage climate-related challenges. 21.25% intercropped with legumes to improve soil health and reduce risks, 32.50% used local knowledge for weather prediction and planning, 31.25% preserved traditional seeds that are better adapted to local conditions, and 15% engaged in communal farming practices for resource sharing.



Source: Primary Data 2025

Fig 4.2.5: Role of government policies and programs in supporting the coping strategies of small-scale maize farmers

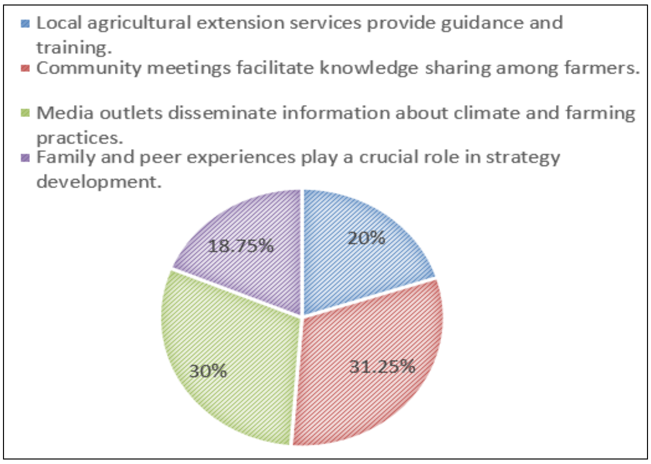
The figure above gives the response of the farmers on the role of government policies and programs in supporting their coping strategies. 24% said that policies provided financial assistance for climate-resilient practices, another 24% said that training programs helped farmers adopt new technologies and practices, 22% said that limited policy implementation hampered effective support, 15% said that government interventions often lacked integration with local needs, and the other 15% said that some programs successfully enhanced community capacity and awareness.



Source: Primary Data 2025

Fig 4.2.6: How socio-economic factors influence the adaptation strategies of small-scale maize farmers

The above pie chart represents the responses of the farmers on how socio-economic factors influence their adaptation strategies. 15% said that higher income allows for investment in better farming technology, 26% said that education level impacts awareness and adoption of new practice, another 26% of the farmers said that access to credit facilitates the purchase of improved seeds and inputs, 18% of the farmers said that social networks provide support and information for adaptation, and 15% of them said that vulnerable households are less able to implement effective strategies.

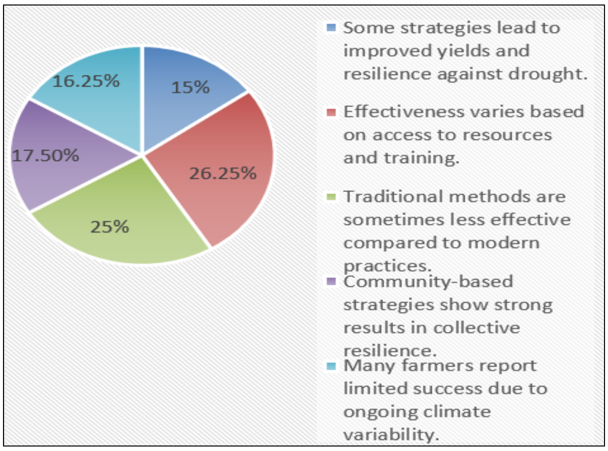


Source: Primary Data 2025

Fig 4.2.7: Sources of information small-scale maize farmers rely on to develop their coping strategies

The figure above shows the response on the sources of information small-scale maize farmers rely on to develop their coping strategies. 20% said local agricultural extension services provided guidance and training, 31.25% said community meetings facilitated knowledge sharing among farmers, 30% said media outlets disseminated information about climate and farming practices, and 18.75% said family and peer experiences played a crucial role in strategy development.

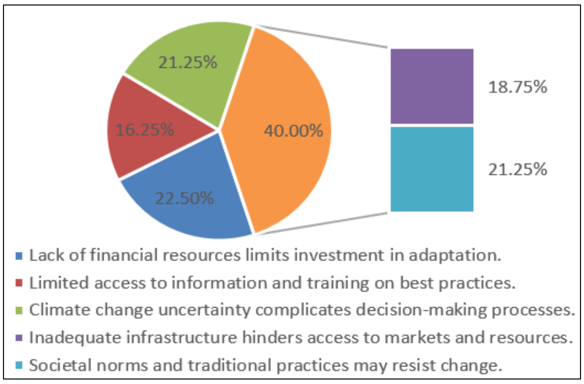
4.3 Effectiveness of the coping strategies used by small scale maize farmers



Source: Primary Data 2025

Fig 4.3.1: Effectiveness of the coping strategies used by small-scale maize farmers in mitigating the impacts of climate change

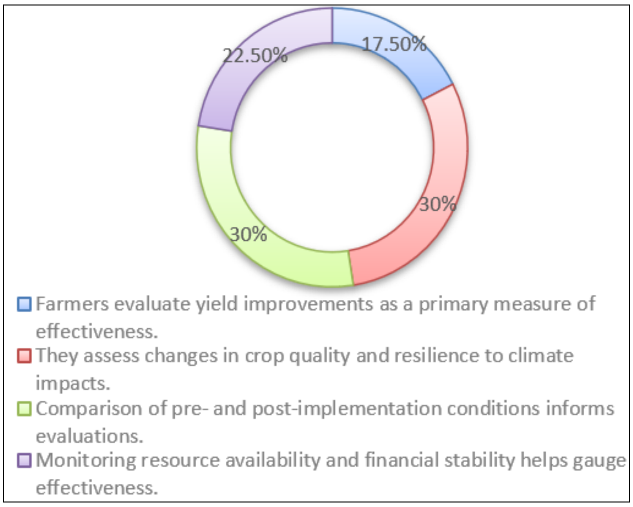
The chart above gives the farmers responses on the effectiveness of the coping strategies used by small-scale maize farmers in mitigating the impacts of climate change. 15% said some strategies led to improved yields and resilience against drought, 26.25% said that effectiveness varied based on access to resources and training, 25% said that traditional methods were sometimes less effective compared to modern practices, 17.50% said that community-based strategies showed strong results in collective resilience, and 16.25% said that Many farmers report limited success due to ongoing climate variability.



Source: Primary Data 2025

Fig 4.3.2: Barriers small-scale maize farmers face in implementing effective coping strategies

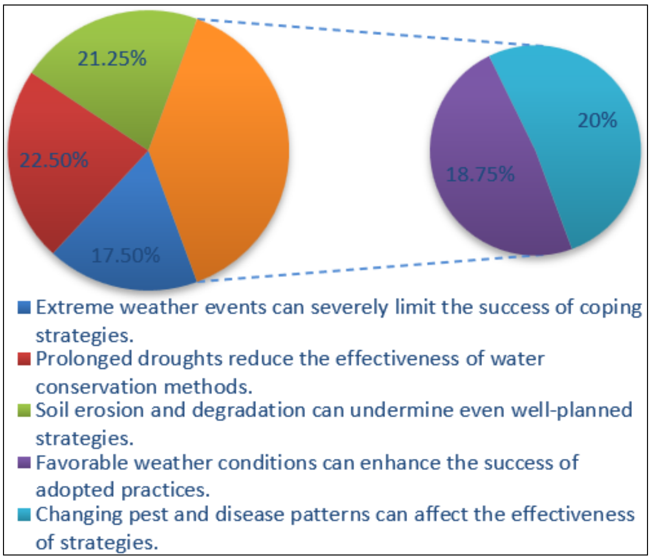
The figure above shows the Barriers small-scale maize farmers face in implementing effective coping strategies. 22.50% said lack of financial resources limits investment in adaptation, 16.25% faced limited access to information and training on best practices, 21.25% faced climate change uncertainties which complicated decision-making processes, 18.75% said inadequate infrastructure hindered access to markets and resources, and 21.25% said societal norms and traditional practices may resist change.



Source: Primary Data 2025

Fig 4.3.3: How small-scale maize farmers assess the effectiveness of their coping strategies

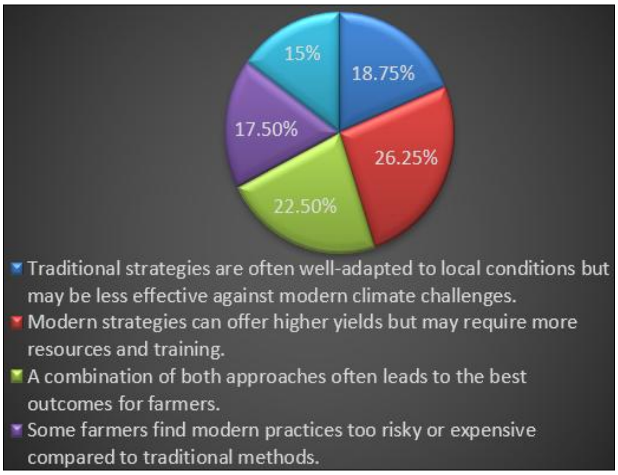
The figure presents the response on how small-scale maize farmers assess the effectiveness of their coping strategies. 17.50% of farmers evaluate yield improvements as a primary measure of effectiveness, 30% of them assess changes in crop quality and resilience to climate impacts, 30% said comparison of pre- and post-implementation conditions informs evaluations, and 22.50% said monitoring resource availability and financial stability helps gauge effectiveness.



Source: Primary Data 2025

Fig 4.3.4: How environmental conditions impact the effectiveness of the coping strategies employed by small-scale maize farmers

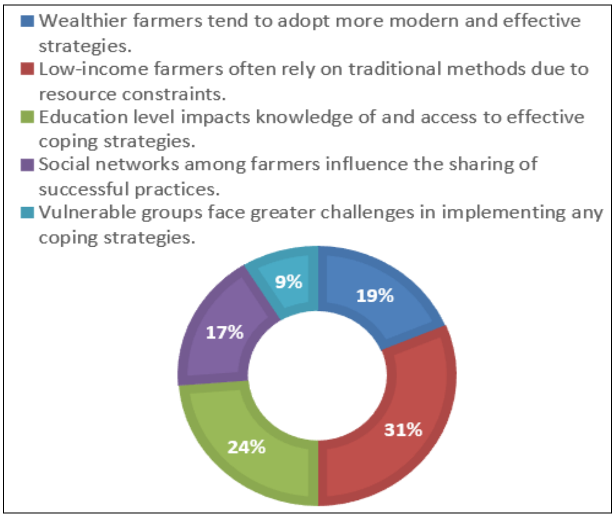
The pie chart shows how environmental conditions impact the effectiveness of the coping strategies employed by small-scale maize farmers. 17.50% said extreme weather events can severely limit the success of coping strategies, 22.50% said prolonged droughts reduce the effectiveness of water conservation methods, 21.25% said soil erosion and degradation can undermine even well-planned strategies, 18.75% said favorable weather conditions can enhance the success of adopted practices, and 20% said changing pest and disease patterns can affect the effectiveness of strategies.



Source: Primary Data 2025

Fig 4.3.5: How traditional and modern coping strategies compare in effectiveness for small-scale maize farmers

The above figure presents how traditional and modern coping strategies compare in effectiveness for small-scale maize farmers. 18.75% said traditional strategies are often well-adapted to local conditions but may be less effective against modern climate challenges, 26.25% said modern strategies can offer higher yields but may require more resources and training, 22.50% said a combination of both approaches often leads to the best outcomes for farmers, 17.50% Some farmers find modern practices too risky or expensive compared to traditional methods, and 15% said Effectiveness varies by region, with some areas benefiting more from traditional practices.

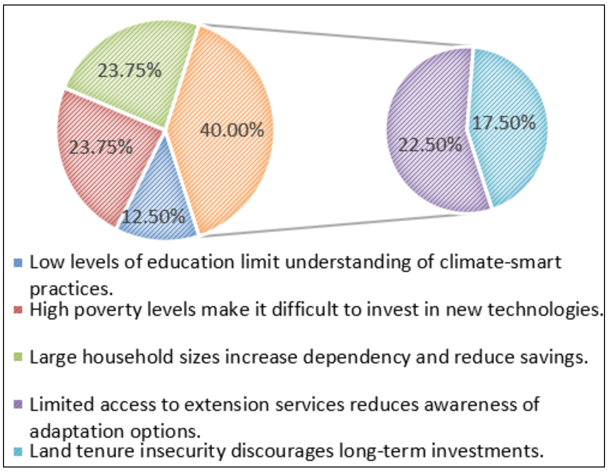


Source: Primary Data 2025.

Fig 4.3.6: How effectiveness of coping strategies varies across different socio-economic groups of farmers

The chart shows how the effectiveness of coping strategies vary across different socio-economic groups of farmers.19% of wealthier farmers tend to adopt more modern and effective strategies, 31% of low-income farmers often rely on traditional methods due to resource constraints 24% said education level impact their knowledge o and access to effective coping strategies. 17% showed that social networks among farmers influence the sharing of successful practices, and 9% showed that vulnerable groups face greater challenges in implementing any coping strategies.

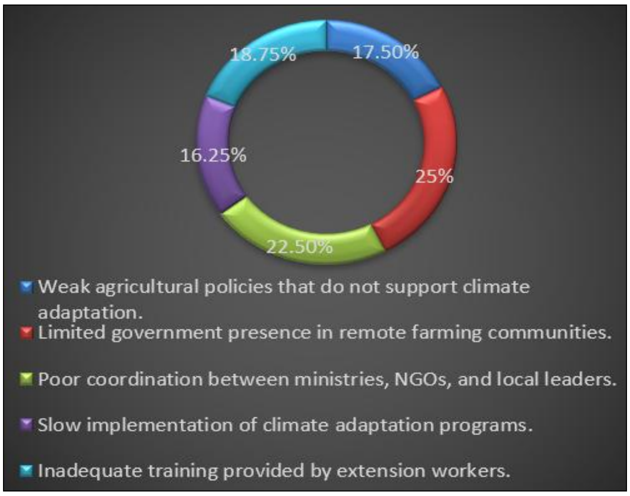
4.4 Limitations of small-scale farmers in adapting to climate change



Source: Primary Data 2025

Fig 4.4.1: How socioeconomic factors limit small-scale farmers' ability to adopt climate change adaptation strategies

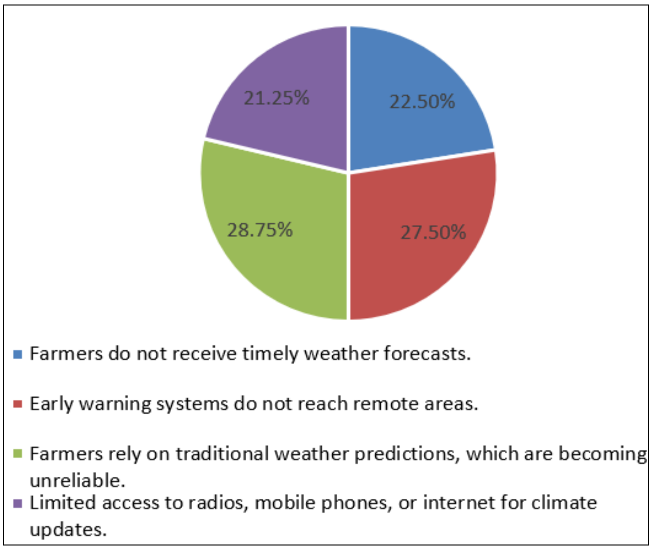
The pie chart above illustrates the response of farmers on how socioeconomic factors limit small-scale farmers' ability to adopt climate change adaptation strategies. 12.50% of the farmers said low levels of education limit understanding of climate-smart practices, 23.75% of them said high poverty levels make it difficult to invest in new technologies, another 23.75% of farmers said large household sizes increase dependency and reduce savings, 22.50% of farmers said limited access to extension services reduces awareness of adaptation options, and 17.50% said land tenure insecurity discourages long-term investments.



Source: Primary Data 2025

Fig 4.4.2: Institutional and policy-related challenges that hinder small-scale farmers' adaptation to climate change

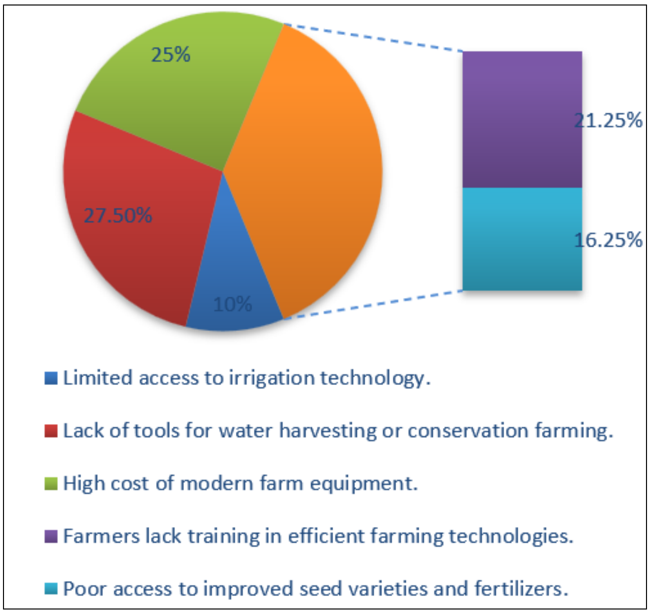
The figure shows the institutional and policy-related challenges that hinder small-scale farmers' adaptation to climate change.17.50% said weak agricultural policies that do not support climate adaptation, 25% said limited government presence in remote farming communities, 22.50% said poor coordination between ministries, NGOs, and local leader, 16.25% said slow implementation of climate adaptation programs, and 18.75% said inadequate training provided by extension workers.



Source: Primary Data 2025

Fig 4.4.3: Extent to which inadequate access to climate information and early warning systems limit farmers' adaptation capacity

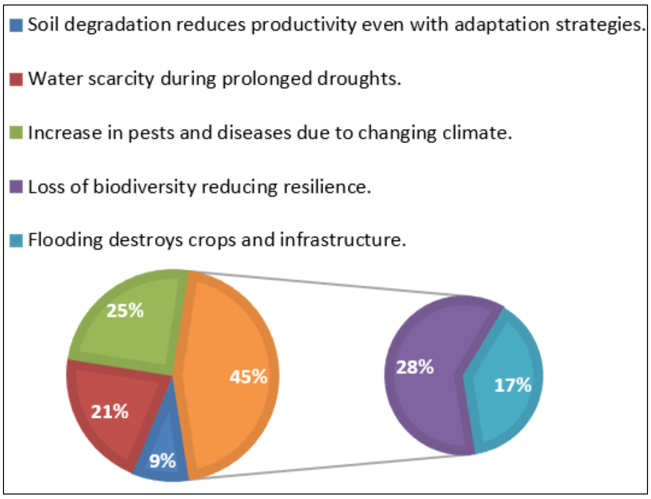
The figure shows the extent to which inadequate access to climate information and early warning systems limit farmers' adaptation capacity. 22.50% of farmers do not receive timely weather forecasts, 27.50% of early warning systems do not reach remote areas, 28.75% of farmers rely on traditional weather predictions, which are becoming unreliable, and 21.25% had limited access to radios, mobile phones, or internet for climate updates.



Source: Primary Data 2025

Fig 4.4.4: How technological limitations and lack of climate-smart agricultural practices impede adaptation among small-scale farmers

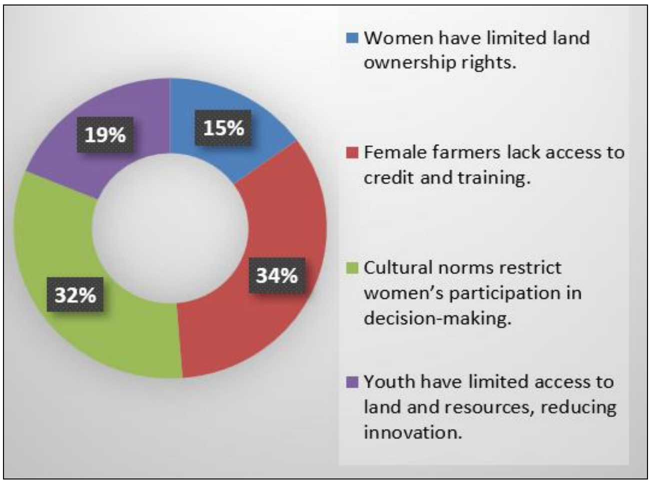
The chart shows how technological limitations and lack of climate-smart agricultural practices impede adaptation among small-scale farmers.10% said limited access to irrigation technology, 27.50% said lack of tools for water harvesting or conservation farming, 25% said high cost of modern farm equipment, 21.25% of farmers lack training in efficient farming technologies, and 16.25% said poor access to improved seed varieties and fertilizers.



Source: Primary Data 2025

Fig 4.4.5: Environmental and ecological barriers that affect the ability of small-scale farmers to respond effectively to climate change

The pie chart above shows the environmental and ecological barriers that affect the ability of small-scale farmers to respond effectively to climate change. 9% said soil degradation reduces productivity even with adaptation strategies, 21% said water scarcity during prolonged droughts.25% said increase in pests and diseases due to changing climate, 28% said loss of biodiversity reducing resilience, and 17% said flooding destroys crops and infrastructure.



Source: Primary Data 2025

Fig 4.4.6: Gender-related or social inequalities limiting participation in climate adaptation initiatives among small-scale farmers

The pie chart above shows how gender-related or social inequalities limit participation in climate adaptation initiatives among small-scale farmers. 15% said women have limited land ownership rights, 34% said female farmers lack access to credit and training, 32% said cultural norms restrict women's participation in decision-making, and 19% said youth have limited access to land and resources, reducing innovation.

4.5 Discussion of Results

The above findings show that the respondents or the farmers are aged 28-70 years, half of them were female and half of them were male. The findings also show the different levels of education of the respondents, 21.25% of which hold Secondary School Certificates, 27.50% hold Diplomas, another 27.50% hold Bachelors' Degree, 16.25% hold Masters' Degrees, and 7.50% hold PhDs. The lower level of education of the respondents affects their agricultural productivity in many ways, some of which being their knowledge and skill (higher education levels can provide farmers with advanced knowledge about crop management, pest control, soil health, and modern farming techniques leading to efficient and effective farming practices), innovation adoption (educated farmers are more likely to adopt new technologies and innovation like improved seed varieties, modern irrigation systems, and precision agriculture tools which can enhance productivity.

From the interpretation of the findings above, it can be deduced that drought has severe impacts on the productivity of most farmers, especially small-scale farmers. It has been seen that increased frequency and intensity of droughts reduced maize yields, unpredictable rainfall patterns led to planting and harvest challenges, and that pests and diseases are more prevalent due to changing climates. In order to cope with the changing climate and improve their productivity or yields, small-scale farmers resort to the implementation of various adaptation strategies. The farmers implemented adaptation strategies such as diversifying crops to reduce dependency on maize alone, some adjusted their planting dates to align with changing rainfall patterns, others implemented water conservation techniques, such as rainwater harvesting, and some utilized improved seed varieties that are more drought-resistant. Some of the coping strategies that the farmers are currently using to manage climate-related challenges are the adoption of drought-resistant seed varieties to improve yields, utilizing traditional knowledge for weather forecasting and planning, and engaging in community support networks for resource sharing. According to Haggblade and Tembo (2013) [16], conservation agriculture has been adopted by over 200,000 farmers in Zambia, primarily through donor-supported programs such as the Conservation Farming Unit (CFU). In a study conducted in Eastern Province, farmers practicing conservation agriculture reported yield increases of up to 60% during periods of low rainfall, compared to those using conventional methods (Nyanga, 2012) [28]. However, uptake is hindered by labor intensity and limited access to inputs like herbicides (Thierfelder *et al*., 2015) [32].

The traditional coping strategies that the farmers employ to manage climate-related challenges are intercropping with legumes to improve soil health and reduce risks, using local knowledge for weather prediction and planning, preserving traditional seeds that are better adapted to local conditions, and engaging in communal farming practices for resource sharing. The government has played vital roles in trying to help farmers cope with the changing weather patterns and improve farmers' yields. The government has implemented policies and programs to support farmers coping strategies. These policies provide financial assistance for climate-resilient practices and provide training programs that help farmers adopt new technologies and practices. Despite some of these government interventions being limited in their implementation, which hampers effective government support, and some interventions lacking integration with local needs, some of these programs have successfully enhanced community capacity and awareness. Another strategy employed by small-scale farmers is diversification of livelihoods and crops. Diversification is a common coping strategy among Zambian smallholders. Farmers diversify both within agriculture (e.g., multiple crops) and outside of it (e.g., petty trading, charcoal burning) to reduce risk exposure. In Monze District, Chinsembu and Chanda (2018) observed that households growing a mix of maize, cassava, and groundnuts were more food secure than mono-cropping households during drought years.

The findings also show how the farmers' socio-economic factors influence their adaptation strategies. Some said that higher income allows for investment in better farming technology, others said that education level impacts awareness and adoption of new practice, for some farmers' access to credit facilitates the purchase of improved seeds and inputs, while some said that social networks provide support and information for adaptation, and the rest said that vulnerable households are less able to implement effective strategies. The farmers relied on various sources of information to develop their coping strategies. Some relied on local agricultural extension services which provided guidance and training, some on community meetings which facilitated knowledge sharing among farmers, some relief on media outlets which disseminated information about climate and farming practices, while others relied on family and peer experiences which played a crucial role in strategy development. These are some of the strategies that the small-scale maize farmers of Kafue District employee in order to cope with the drastic changes of weather patterns and climate change.

According to the findings, some of the coping strategies employed by the small-scale maize farmers of Kafue proved to be effective while some were not that effective in mitigating the impacts of climate change. Some farmers responded that some strategies led to improved yields and resilience against drought, some said that the effectiveness of the strategies varied based on access to resources and training. Other farmers responded that traditional methods were sometimes less effective compared to modern practices, some said community-based strategies showed strong results in collective resilience, and other farmers reported limited success due to ongoing climate variability. A study in Southern Province found that farmers who practiced crop diversification by growing drought-tolerant crops like cowpeas and groundnuts alongside maize had better harvest outcomes during the 2015/16 El Niño-induced drought (Ngoma, 2018). These households reported lower food deficits and greater resilience. This strategy may be limited in its effectiveness as market access for non-maize crops remains weak, reducing the economic benefits of diversification.

According to the findings of objective three, socioeconomic factors limit small-scale farmers' ability to adopt climate change adaptation strategies. This is due to low levels of education which limit understanding of climate-smart practices, high poverty levels which make it difficult to invest in new technologies, large household sizes which increase dependency and reduce savings, limited access to extension services which reduces awareness of adaptation options, and land tenure insecurity which discourages long-term investments. Gender-related or social inequalities limit participation in climate adaptation initiatives among small-scale farmers. This is mainly because women have limited land ownership rights, female farmers lack access to credit and training, cultural norms restrict women's participation in decision-making, and youth have limited access to land and resources, reducing innovation. Just as in the literature review, low literacy/education levels, limited access to formal training, and gendered barriers (women's reduced access to land, credit, extension) restrict some households' capacity to adopt complex or capital-intensive adaptation practices. Vulnerable groups, women, the elderly, persons with disabilities, are often less reached by programs, reducing household and community resilience (The Guardian, 2024).

The findings also showed the extent to which inadequate access to climate information and early warning systems limit farmers' adaptation capacity. Most farmers did not receive timely weather forecasts, early warning systems did not reach remote areas, some farmers relied on traditional weather predictions, which were becoming unreliable, and some had limited access to radios, mobile phones, or internet for climate updates. Some of the technological limitations and lack of climate-smart agricultural practices that impede adaptation among small-scale farmers were limited access to irrigation technology, lack of tools for water harvesting or conservation farming, high cost of modern farm equipment, lack training in efficient farming technologies, and poor access to improved seed varieties and fertilizers. According to Tembo-Nhlema *et al*., (2021), access to weather forecasts and extension services enhances adaptive capacity. Radio, mobile phones, and farmer field schools are used to disseminate climate information. However, access remains uneven across regions and among gender groups, limiting the effectiveness of these strategies.

Environmental and ecological barriers that affected the ability of small-scale farmers to respond effectively to climate change were soil degradation reduces productivity even with adaptation strategies, water scarcity during prolonged droughts, increase in pests and diseases due to changing climate, loss of biodiversity reducing resilience, and flooding which destroys crops and infrastructure. The institutional and policy-related challenges that hindered small-scale farmers' adaptation to climate change were weak agricultural policies that do not support climate adaptation, limited government presence in remote farming communities, poor coordination between ministries, NGOs, and local leader, slow implementation of climate adaptation programs, and inadequate training provided by extension workers. According to Chavula (2022) these limitations act together, lack of finance and irrigation makes farmers vulnerable to drought; weak extension and localized forecasts reduce timely decisions; poor markets and storage make investments uneconomic; institutional and tenure issues limit sustainability of improvements; and acute shocks can wipe out savings. Thus, hindering any progress made by the farmers in trying to adapt to climate change.

5. Conclusion

In summary, the findings show that many small-scale farmers are facing severe losses and low crop productivity due to climate change and only a few portions of farmers are able to cope with or come up with proper adaptation strategies to reduce the impact of climate change on their yields. Increased frequencies and intensities of droughts reduced maize yields, unpredictable rainfall patterns led to planting and harvest challenges, and those pests and diseases are more prevalent due to changing climates. Most farmers resorted to employing traditional coping strategies in order to manage climate-related challenges because most of them found the traditional coping strategies much cheaper than the modern technical strategies of coping to climate change. Most farmers' socio-economic factors also hindered them from employing effective coping strategies because those with low socio-economic statuses could not afford the technological equipment to use to increase their yields. Though some of the coping strategies employed by the small-scale farmers were effective, some proved not to be that effective in terms of improving crop yields. The factors that affected the effectiveness of these coping strategies are environmental conditions and the socio-economic statuses of the farmers. It is for this reason that most farmers decided to incorporate traditional coping strategies into their farming practices so as to increase the effectiveness of their coping strategies. Most farmers modified their planting schedules, some utilized technology and innovation, while others incorporate traditional strategies and practice so as to improve their yields. Government policies have also played important roles in improving or declining of the effectiveness of the coping strategies employed by most farmers. Therefore, the government should ensure to develop and implement policies that aim for improving the effectiveness of these coping strategies.

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