Int. j. adv. multidisc. res. stud. 2026; 6(1):2659-2667

Received: 02-01-2026
Accepted: 06-02-2026

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Effects of Climate Change on Household Food Security: A Case of Mulobezi District

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DOI: https://doi.org/10.62225/2583049X.2026.6.1.5831

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Abstract

The study examined the effects of climate change on household food security in Mulobezi District, Western Province of Zambia. Guided by the Vulnerability and Resilience Framework, it focused on the impact of climate change on household income, food accessibility, and coping strategies among smallholder farmers. A mixed-methods approach was used, involving surveys of 100 households and interviews with key informants. Results showed that 73% of respondents experienced reduced income due to droughts, irregular rainfall, and rising input costs, with farming being the most affected activity. More than half of the households reported poor food access, and 70% observed increased food prices during droughts. Coping strategies included crop diversification, off-farm business, livestock rearing, and small-scale irrigation, while financial responses involved savings, asset sales, and borrowing. Only a few households received support from NGOs and government agencies. The study concludes that climate change has weakened income stability, food access, and livelihood resilience, recommending drought-tolerant crops, irrigation expansion, improved access to credit and insurance, and stronger institutional coordination.

Keywords: Climate Change, Food Security, Adaptation, Resilience, Mulobezi District, Zambia

1. Introduction

Climate change is a global phenomenon characterized by long-term shifts in temperature and rainfall patterns, increasingly threatening sustainable development and food security. Driven by greenhouse gas emissions from human activities such as deforestation and fossil fuel use, it disrupts ecosystems and agricultural systems worldwide (Tembo and Sarzhanov, 2013 [36]; Masson-Delmotte *et al*., 2019). Agriculture, the main livelihood for most rural populations, is especially vulnerable; erratic rainfall, droughts, and heat stress reduce yields and increase production costs, undermining food availability and access (Muyabe, *et al*., 2024) [24].

In Zambia, where over 70 % of people depend on agriculture, rising temperatures and unpredictable rainfall have intensified droughts and floods. These climatic shifts threaten the nation's food systems, with Mulobezi District being particularly affected due to its reliance on rain-fed farming. Studies show that 70 % of households in the district are food insecure and many live below the poverty line. Such conditions are worsened by limited access to inputs, markets, and climate information, leaving households increasingly vulnerable to shocks.

This study analyses how climate change affects household food security in Mulobezi by examining its influence on income, food access, and coping strategies. Using the Vulnerability and Resilience Framework (VRF), the research explores how exposure, sensitivity, and adaptive capacity determine household vulnerability and resilience to climate-related shocks. The framework also identifies how access to resources, social networks, and institutional support enhances adaptation through practices such as income diversification and climate-smart agriculture.

The study is significant because it provides empirical evidence to guide climate adaptation and food-security policies in Zambia. It supports the Sustainable Development Goals (SDGs) on zero hunger and climate action by informing strategies that enhance resilience among vulnerable rural populations. While focused on Mulobezi, the findings offer insights relevant to other regions facing similar climatic challenges. Ultimately, this research contributes to understanding how households can strengthen their livelihoods and food security in the face of increasing climate variability.

2. Literature Review

Climate change exerts profound socioeconomic and environmental impacts across the globe, influencing food systems, labor productivity, and household welfare. It heightens inequality within and between countries as poorer households experience disproportionate exposure and reduced adaptive capacity (Mendelsohn, 2008; Muyabe, Tembo, *et al.*, 2025) [18, 25].

In sub-Saharan Africa, agriculture remains the primary livelihood for over 50 percent of the labour force, yet its rainfed nature exposes it to climatic shocks. In Zambia, projections show shortened growing seasons, a 13 percent decline in water availability by 2050, and widening poverty gaps (Tembo *et al.*, 2025) [35]. These conditions directly suppress household income through reduced yields and indirectly through price volatility and employment losses (Mendelsohn and Wang, 2017).

Climate change also threatens food accessibility by disrupting agricultural production and increasing food prices. Droughts and floods reduce yields and market supplies, while water scarcity and pest infestations aggravate food insecurity (Chola *et al*., 2025; Mendelsohn and Wang, 2017; Phiri *et al*., 2025 [30]). Studies in Africa suggest that maize yields may fall by 10 to 20 percent by 2050, particularly affecting rural households reliant on subsistence farming (Jones and Thornton, 2003; Alubi *et al*., 2024) [12, 2]. Similar patterns in Zambia's Western and Southern Provinces reveal reduced maize production and income losses. Households employ diverse coping strategies to mitigate these effects. Common approaches include diversification of income, conservation agriculture, adoption of climate-resilient crops, irrigation, agroforestry, and social support networks (Muyabe, *et al*. 2025) [23]. Conservation agriculture, which involves mulching, minimum tillage, and crop rotation, has improved soil fertility and maize yields in Zambia by up to 30 percent (Ngoma *et al.*, 2021a; Tembo, 2025) [27, 34]. Other adaptive measures such as climate information services and off-farm income sources, including remittances, further enhance resilience.

Despite progress, literature gaps persist. Global studies often neglect localized vulnerabilities and gendered experiences (Robert *et al*., (2025). Zambian studies rarely examine long-term household dynamics or urban food insecurity, relying mainly on cross-sectional data. Moreover, there is limited empirical evaluation of policy effectiveness in strengthening resilience and integrating climate adaptation with food security planning.

Overall, the literature underscores that climate change undermines household food security through declining income, constrained food access, and reduced adaptive capacity. However, strengthening local adaptation strategies, enhancing gender-inclusive resilience, and promoting evidence-based agricultural policies remain critical for mitigating impacts in vulnerable districts such as Mulobezi.

3. Methods

This study used a mixed-methods research design combining qualitative and quantitative approaches to examine the effects of climate change on household food security in Mulobezi District. The design enabled a deeper understanding of both statistical patterns and personal experiences related to climate impacts. The target population comprised household heads, and purposive sampling was employed to select 100 respondents who had firsthand experience with climate variability. Data were collected using structured questionnaires, interviews, and focus group discussions, complemented by document review to ensure data richness.

Data were analysed using thematic analysis for qualitative information and SPSS and Excel for quantitative data. Findings were presented in tables, charts, and graphs to illustrate key trends. Triangulation was applied to enhance the credibility and validity of results by comparing data from multiple sources. The study observed some limitations, including difficulties in isolating climate effects from other socioeconomic factors and communication challenges due to language barriers. Strict ethical standards were maintained, including informed consent, confidentiality, and voluntary participation, ensuring participant dignity and research integrity.

4. Results and Discussion

4.1 Overview

This chapter presents and discusses the findings of the study based on data collected from 100 respondents in Mulobezi District, Western Province. The presentation of results follows the order of the study objectives. The first part provides the demographic characteristics of respondents, while the subsequent sections discuss the impact of climate change on household income, effects on household food accessibility, and coping strategies adopted by households including climate-related support. The chapter integrates quantitative and qualitative analyses to explain the results, Supported by relevant literature. Figures and tables are used to summarize the data for easy interpretation. The findings reflect how climate change has influenced the socio-economic status and adaptive capacities of farming households in the district.

4.2 Demographic Characteristics of Respondents

The demographic characteristics of respondents were examined to provide context on household composition, literacy, and livelihood activities, which influence how communities respond to the impacts of climate change in Mulobezi District. The variables analysed include gender, age, marital status, education level, and occupation.

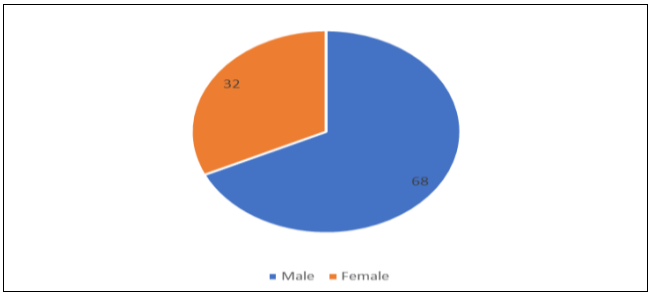

Fig 1: Gender Distribution of Respondents

Figure 1 presents the gender distribution of respondents who participated in the study. Out of 100 respondents, 68 (68 %) were male and 32 (32 %) were female. This finding indicates a slight predominance of male participants, reflecting the traditional household structure in which men are often the main representatives in community engagements and surveys. Nevertheless, the participation of women (32 %) shows their increasing involvement in agricultural production and decision-making processes.

FAO, (2019) [8] emphasizes that women play a crucial role in smallholder agriculture, contributing substantially to food production, post-harvest handling, and climate-adaptation practices.

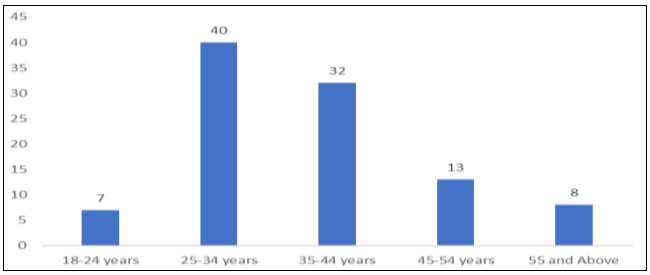

Fig 2: Age Distribution of Respondents

Figure 2 presents the age distribution of the respondents. Most participants, 40 (40 %), were between 25 and 34 years old, followed by 32 (32 %) aged between 35-44 years and 7(7 %) aged below 25. This pattern shows that the majority of respondents were middle-aged adults actively engaged in farming and community work. According to Mohebi *et al*., (2018) [22], middle-aged farmers tend to be more productive and adaptive to technological change than older or very young farmers. The presence of elderly respondents 8(8%) also suggests a wealth of local knowledge regarding weather patterns and traditional coping strategies.

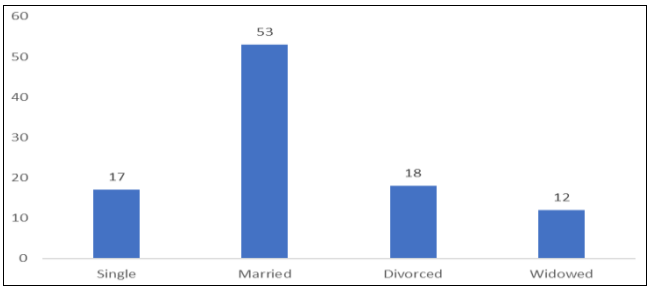

Fig 3: Marital Status of Respondents

Figure 3 presents the marital status of respondents. The majority, 53 (53 %), were married, while 17 (17 %) were single, 12 (12 %) widowed, and 18 (18 %) divorced. The high proportion of married respondents indicates that most households have access to family labour, an important asset in agricultural production and adaptation activities. (Chandra Babu, 2014) [6] observed that family labour enhances resilience by enabling the timely execution of farm operations such as planting and harvesting during favourable weather windows.

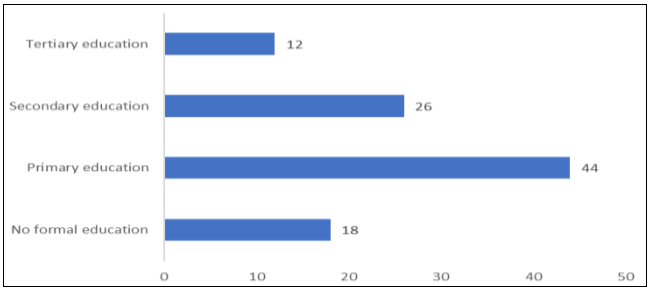

Fig 4: Educational Level of Respondents

Figure 4 presents the educational attainment of respondents. Most respondents, 44 (44 %), had primary education, 26 (26 %) secondary, 12 (12 %) tertiary, and 18 (18 %) no formal education. This implies that a substantial portion of households possess basic literacy skills that can facilitate understanding of climate information and extension services. (FAO, 2019b) [9] both highlight education as a determinant of adoption of climate-smart agriculture and interpretation of meteorological advice. However, the presence of farmers without formal education (18%) signals the need for tailored communication approaches through visual and oral methods to enhance knowledge transfer.

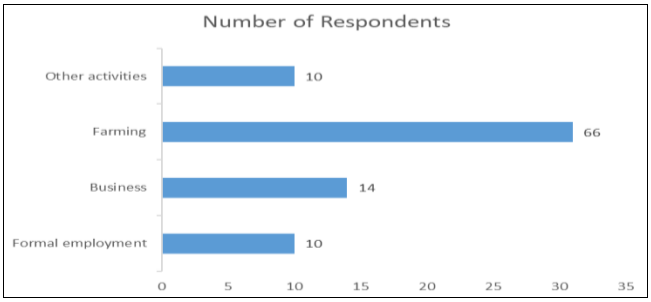

Fig 5: Main Occupation of Respondents

Figure 5 presents the principal occupation of respondents in Mulobezi District. Farming was the dominant occupation, accounting for 66 (66 %) of respondents, followed by business 14 (14 %), formal employment 10 (10 %), and other activities 10 (10 %). This confirms that the local economy is predominantly agriculture-based and dependent on rain-fed production. Such dependence exposes households to climate-related risks including droughts and floods. According to Omotoso *et al*. (2023) [29], communities whose livelihoods are largely dependent on rain-fed agriculture are highly vulnerable to the adverse effects of climate variability. Ngoma *et al*., (2021) [28] also notes that limited livelihood diversification in rural Zambia reduces adaptive capacity to cope with economic and environmental stress.

4.3 Impact of Climate Change on Household Income

This section analyses how climate variability has affected the income sources of households in Mulobezi District. The responses highlight reductions in farm earnings, changes in livelihood activities, and the main climatic factors influencing these trends.

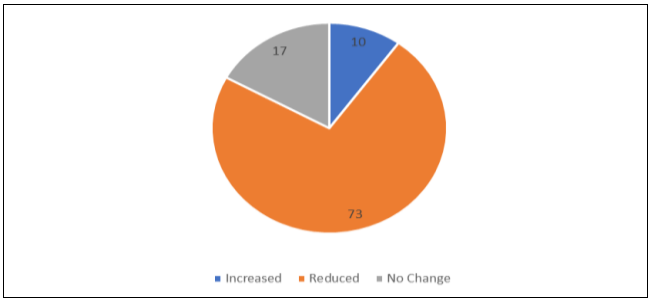

Fig 6: Nature of Income Change Experienced by Households

Figure 6 presents the nature of income change reported by respondents in relation to climate change. Out of 100 households, 73 (73 %) reported reduced income, 17 (17 %) indicated no change, and 10 (10 %) experienced an increase. The predominance of income reduction confirms that recurrent droughts and erratic rainfall patterns have lowered

crop yields and marketable surpluses. This aligns with findings by Muyabe *et al*. (2025) [23], who reported declining smallholder incomes due to shortened rainy seasons and prolonged dry spells in southern Zambia. According to (Masson-Delmotte *et al*. (2019), these climatic stressors diminish household purchasing power and threaten rural livelihoods dependent on rain-fed farming.

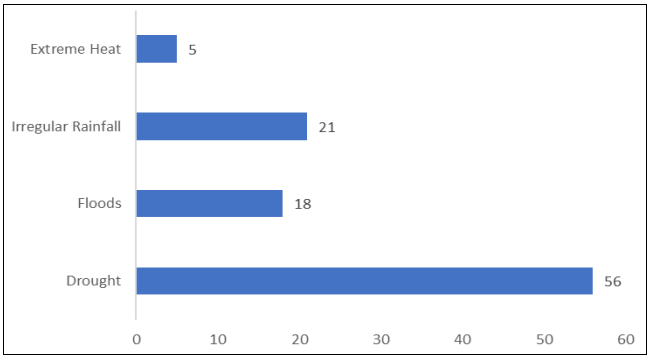

Fig 7: Major Climate Factors Affecting Household Income

Figure 7 presents the major climate-related factors that have influenced household income. The majority of respondents, 56 (56 %), cited drought as the most significant factor, followed by irregular rainfall 21 (21 %), floods 18 (18 %), and extreme heat 5 (5 %). This indicates that drought is the dominant hazard in the district, consistent with its semi-arid climatic conditions. (FAO, 2019b) [9] notes that repeated drought episodes disrupt production cycles and deplete household assets, while Lubungu, Burke and Sitko, (2013) [14] observed that frequent dry spells compel households to adopt survival rather than investment-oriented livelihood strategies.

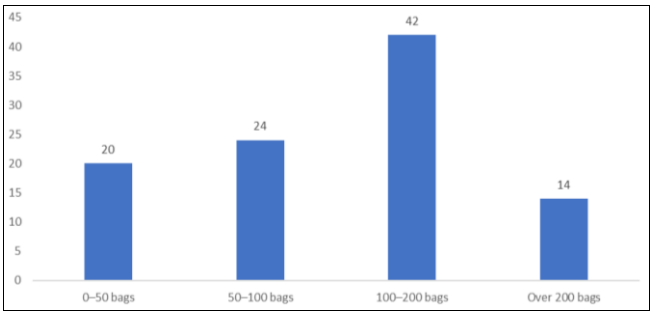

Fig 8: Effect of climate change on Maize yield in the 2022/2023 farming season

Figure 8 presents the effect of climate change on maize yield during the 2022/2023 farming season. The majority of respondents, 64 (64 %), reported a significant decline in maize yield, while 23 (23 %) observed a moderate decline, and only 13 (13 %) indicated that yields had remained stable or improved. These findings indicate that the 2022/2023 season was adversely affected by erratic rainfall and prolonged dry spells, which limited soil moisture and shortened the growing period. The results are consistent with the findings of Mwape *et al*., (2025) [26] who reported that Western Province experienced below-average rainfall during that season, leading to reduced maize productivity. Similarly, Hoddinott *et al*. (2011) found that climatic variability, particularly drought and heat stress, has a strong negative correlation with maize output in southern Zambia, where most farmers rely on rain-fed agriculture.

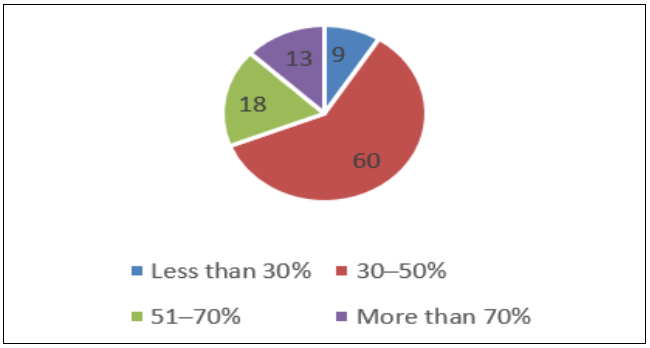

Fig 9: Extent of climate change on Maize yield reduction in the 2022/2023 farming season

Figure 9 presents the major indicators of food accessibility among households affected by climate change. The majority of respondents, 52 (52 %), rated their access to food as poor, while 20 (20 %) rated it as very poor. Only 18 (18 %) of the respondents indicated fair access, and 10 (10 %) reported good access to food. These results suggest that most households face significant difficulties in obtaining adequate and nutritious food throughout the year. The findings reflect the broader situation reported by the Food and Agriculture Organization (FAO, 2019) [8], which highlights that irregular rainfall and reduced crop yield often lead to food shortages and increased prices in rural areas. (Ilo, Ilo and Simatele, 2025) [11] also noted that in regions such as Western Province, climate variability disrupts local food systems and market supply, reducing the ability of households to secure sufficient food even when prices remain relatively stable.

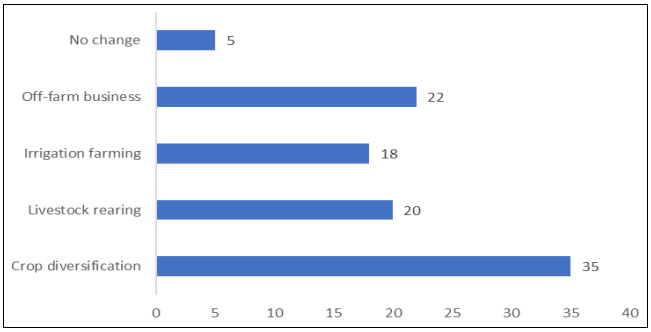

Fig 10: Changes in Major Livelihood Activities Due to Climate Change

Figure 10 presents the findings on how climate change has compelled shifts in livelihood activities. Thirty-five (35 %) of the respondents reported taking up crop diversification, 20 (20 %) turned to livestock rearing, 18 (18 %) engaged in irrigation farming, 22 (22 %) started off-farm businesses, and 5 (5 %) had made no change. The results indicate a growing trend toward livelihood diversification as an adaptive strategy to stabilize income. Mihrete and Mihretu, (2025) [21] explains that diversification of crops and non-farm enterprises enhances resilience by spreading risk across multiple income streams. Similarly, Baker *et al*., (2023) [5] found that mixed-livelihood systems in Western Province help farmers maintain household cash flow during poor agricultural seasons.

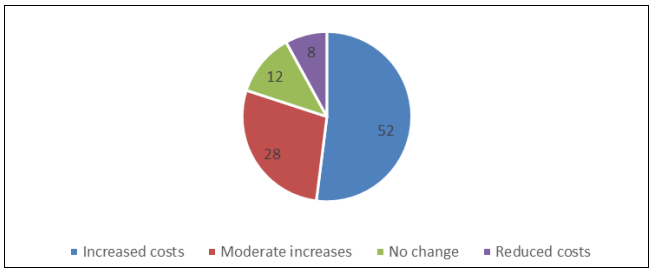

Fig 11: Household Perceptions of Market and Input Costs under Climate Stress

Figure 11 presents respondents' perceptions of changing market and input costs under climate stress. Fifty-two (52 %) indicated that transportation and input costs had increased, 28 (28 %) reported moderate increases, 12 (12 %) no change, and 8 (8 %) observed reductions. The data suggest that climatic disturbances not only reduce yields but also raise production costs through higher prices for water, feed, and energy. Akpa, (2024) [1] notes that such secondary economic effects deepen rural poverty, while (Simatele, 2010) [32] reports that market volatility worsens the vulnerability of small-scale farmers already constrained by limited financial capital. The results from Figures 6 to 9 demonstrate that climate change has significantly undermined the income base of households in Mulobezi District through reduced yields, increased costs, and forced diversification. These findings corroborate national observations by (Mihrete and Mihretu, 2025) [21] that climate variability remains a major economic driver of rural poverty in Zambia.

4.4 Effects of Climate Change on Household Food Accessibility

This section presents findings on how climate change has affected the ability of households in Mulobezi District to access adequate food. The data reveal changes in meal frequency, food availability, and the general household perception of food security during drought and erratic rainfall periods.

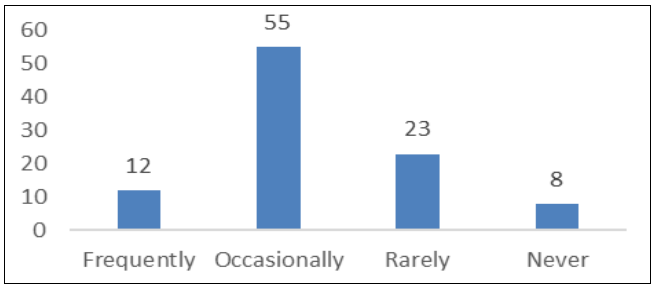

Fig 12: Frequency of experiencing difficulties *accessing* food due to climate related

Figure 12 presents the frequency of households experiencing difficulties in accessing food due to climate-related factors. The majority of respondents, 48 (48%), reported that they often experienced food access challenges, while 33 (33%) indicated that such difficulties occurred occasionally. Only 12 (12%) stated that they rarely faced these challenges, and 7 (7%) reported never experiencing them. These results reveal that a significant proportion of households in Mulobezi regularly struggle to access sufficient food, largely as a result of climate-induced disruptions such as droughts and irregular rainfall. The findings are consistent with the Intergovernmental Panel on Climate Change (Masson-Delmotte *et al.*, 2021) [15], which emphasizes that increased climate variability heightens food insecurity, especially among rural populations dependent on rain-fed agriculture. Similarly, Simatele, (2010) [32] observed that recurrent drought episodes in Zambia undermine household purchasing power and limit food supply, thereby exacerbating hunger and malnutrition among vulnerable communities.

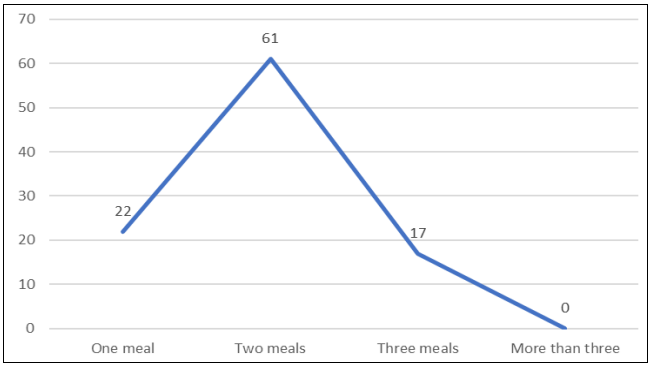

Fig 13: Number of Meals per Day During the Dry Season

Figure 13 presents the number of meals households consumed per day during the dry season. The results show that 61 (61 %) of respondents reported consuming two meals per day, 22 (22 %) consumed one meal, while 17 (17 %) had three meals. These findings suggest that food availability declines during dry periods, forcing households to reduce meal frequency. Similar results were documented by Mwape *et al.*, (2025) [26], which reported that prolonged droughts lead to seasonal hunger and rationing of food in most rural parts of Zambia. Reduced meal frequency is a coping strategy to extend limited food supplies over time.

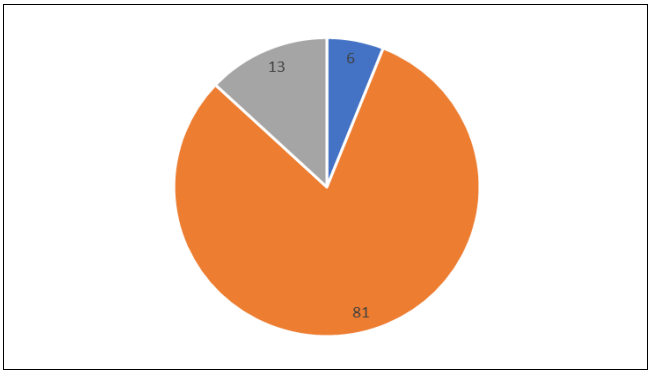

Fig 14: Changes in Household Food Availability Over the Years

Figure 14 presents the findings on changes in household food availability due to climate change. A total of 81 (81 %) of respondents reported that food availability had reduced, 13 (13 %) indicated no change, while only 6 (6 %) reported an increase. The results demonstrate that climate variability has led to lower crop yields and shorter storage periods, limiting the amount of food available for household consumption. These findings agree with (Masson-Delmotte *et al.*, 2019), which highlights that reduced rainfall and increased temperature variations significantly lower agricultural productivity and food stocks in southern Africa.

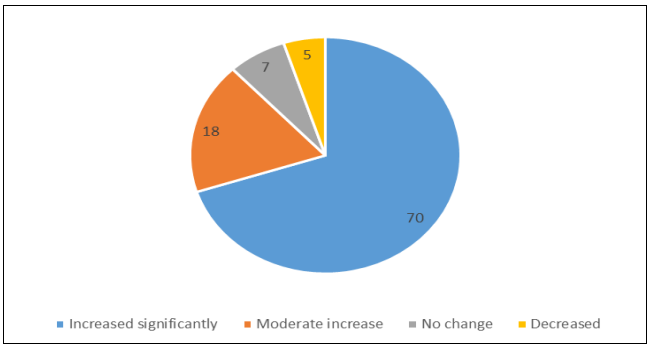

Fig 15: Household Access to Food Under Changing Climate Conditions

Figure 15 presents household perceptions of access to food under changing climate conditions. More than half of the respondents, 52 (52 %), rated their food access as poor, 20 (20 %) rated it as very poor, 23 (23 %) as good, and only 5 (5 %) as very good. The results indicate widespread difficulty in accessing sufficient food, largely due to crop failures and income constraints. Araya *et al*., (2023) [4] climate shocks diminish both production and purchasing power, leading to reduced household food access. Ansell *et al*., (2009) [3] similarly observed that food insecurity is most severe among household's dependent on rain-fed farming, as declining yields immediately translate into lower food availability and accessibility.

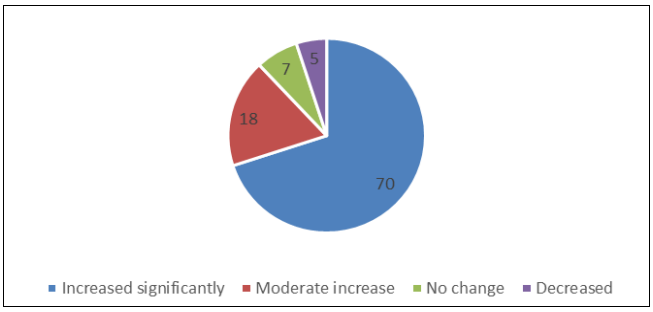

Fig 16: Impact of Climate Change on Food Prices

Figure 16 presents respondents' perceptions of food price changes attributed to climate variability. Seventy (70 %) reported that food prices had increased significantly, 18 (18 %) observed moderate increases, 7 (7 %) no change, and 5 (5 %) decreases. These findings indicate that poor harvests and supply shortages during drought seasons drive up market prices, thereby restricting household food purchasing ability. Similar patterns were documented by (Simatele, 2010a) [32], who found that climate-induced production shocks often trigger food price inflation, further straining rural consumers' capacity to maintain stable diets. Overall, the findings reveal that climate change has negatively affected household food accessibility in Mulobezi District. Reduced harvests, fewer daily meals, and higher food prices have combined to heighten food insecurity. These findings are consistent with FAO (2020) and IPCC (2021), who assert that the frequency of droughts and erratic rainfall patterns in Zambia continues to undermine rural food systems.

4.5 Coping Strategies and Climate-Related Support

This section presents and discusses the measures households in Mulobezi District employ to cope with the effects of climate change, including livelihood adjustments, water management, financial mechanisms, and external support. The results highlight both household-level and institutional responses to climate-induced stress.

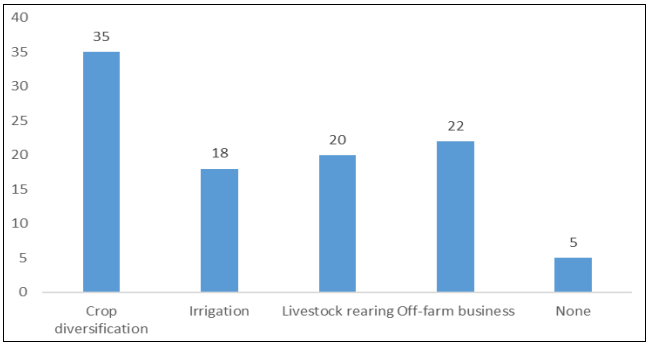

Fig 17: Livelihood Coping Strategies Adopted by Households

Figure 17 presents the livelihood strategies that households adopted to cope with climate shocks. The data show that 35 (35 %) of respondents engaged in crop diversification, 18 (18 %) practised irrigation, 20 (20 %) turned to livestock rearing, 22 (22 %) started off-farm businesses, and 5 (5 %) had not adopted any coping strategy. The findings indicate a strong preference for diversification as a resilience strategy. According to Tortola, (2024) [37], diversified livelihoods help spread risk and stabilize income in times of climate uncertainty. Similarly, Baker *et al*., (2023) [5] observed that mixed farming systems combining crops, livestock, and non-farm activities increase households' adaptive capacity.

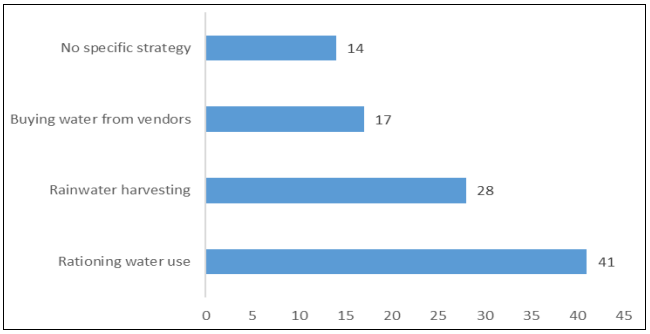

Fig 18: Water Management Strategies During Droughts

Figure 18 presents the findings on how households manage water scarcity during droughts. Forty-one (41 %) of respondents relied on rationing water use, 28 (28 %) used rainwater harvesting, 17 (17 %) purchased water from vendors, and 14 (14 %) had no specific strategy. The results show that rationing and small-scale water collection are the most common adaptive practices. Ilo and Simatele, (2025) stresses that water conservation measures such as rainwater harvesting and efficient use significantly improve drought resilience among smallholder farmers. However, the 14 % of households without coping mechanisms remain highly vulnerable to prolonged dry spells.

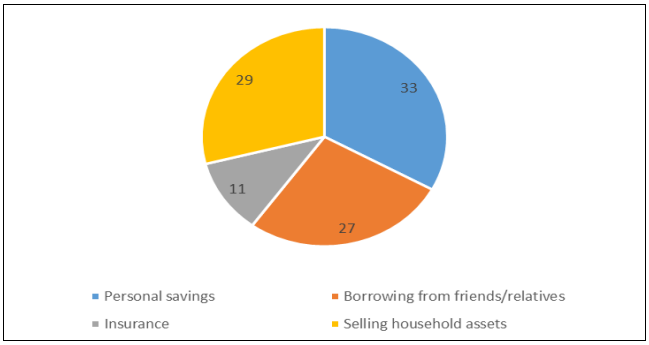

Fig 19: Financial Coping Mechanisms for Climate-Related Shocks

Figure 19 presents household financial responses to climate-related shocks. Thirty-three (33 %) of respondents reported using personal savings, 27 (27 %) borrowed from friends or relatives, 11 (11 %) relied on insurance, and 29 (29 %) sold household assets. The data show that informal mechanisms such as borrowing and selling assets are dominant. Lee and Gambiza, (2022) [13] notes that limited access to formal credit institutions forces many rural households to depend on social networks during crises, while Tembo and Simatele, (2010) emphasize that strengthening rural microfinance is essential for sustainable adaptation.

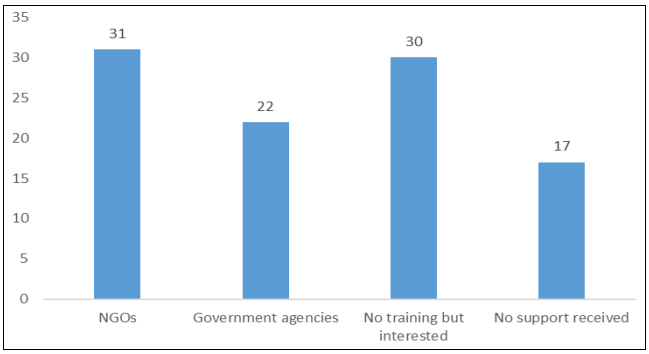

Fig 20: Climate-Change-Related Training and Support Received

Figure 20 presents the sources of climate-change-related training and support received by households. Thirty-one (31 %) had received assistance from NGOs, 22 (22 %) from government agencies, 30 (30 %) had not received any training but were interested, and 17 (17 %) had received no support at all. The results indicate that NGOs are the leading providers of climate information and adaptation training in Mulobezi District. This finding supports FAO, (2019) [8], which reported that non-governmental organizations play a vital role in disseminating climate information, promoting conservation practices, and building community capacity for resilience.

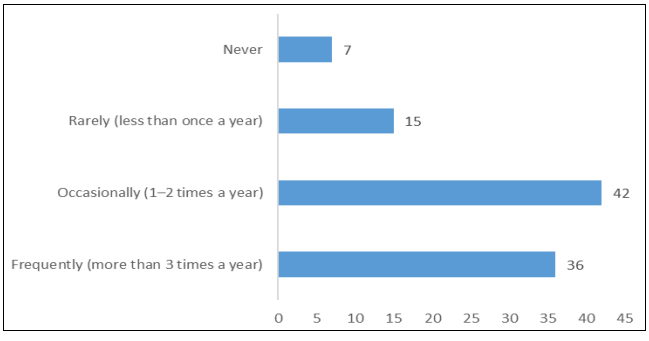

Fig 21: Frequency of Reliance on Non-Farm Income Sources

Figure 21 presents the frequency with which households rely on non-farm income to supplement food and other expenses. Thirty-six (36 %) reported doing so frequently (more than three times a year), 42 (42 %) occasionally (once or twice a year), 15 (15 %) rarely (less than once a year), and 7 (7 %) never. The results illustrate that most households now depend on off-farm activities as a supplementary safety net. According to Field and Barros, (2014) [10], such diversification is an adaptive livelihood strategy that reduces vulnerability to agricultural income fluctuations caused by climate change. Overall, the results presented in Figures 14 to 18 reveal that households in Mulobezi District have developed multiple coping strategies to counter the adverse effects of climate variability. Nevertheless, the predominance of informal and subsistence-based adaptations indicates that institutional and infrastructural support remains inadequate. Strengthening formal safety nets, irrigation systems, and credit facilities would significantly enhance community resilience.

5. Conclusion

This study assessed the effects of climate change on household food security in Mulobezi District, focusing on income stability, food accessibility, and coping mechanisms. The findings revealed that recurrent droughts, erratic rainfall, and rising temperatures have significantly disrupted rural livelihoods and reduced agricultural productivity. Approximately seventy-three percent of households experienced income decline, largely due to poor harvests and increased input costs, while over half of respondents reported poor food access compounded by rising food prices during drought seasons. These outcomes confirm that climate variability has intensified vulnerability among smallholder farmers whose livelihoods depend on rain-fed agriculture. Although households adopted several coping strategies, including crop diversification, off-farm enterprises, and irrigation, most responses were short-term and reactive, reflecting limited institutional and policy support. Strengthening resilience through climate-smart agriculture, improved market systems, and enhanced institutional coordination remains essential for safeguarding food security and achieving Sustainable Development Goal 2 (Zero Hunger) in Zambia.

6. Recommendations

The study recommends strengthening climate resilience in Mulobezi through coordinated actions at all levels. Households should adopt drought-tolerant crops, climate-smart farming, and small-scale irrigation supported by credit access. Communities need grain reserves, better food markets, and nutrition education. Institutions should expand climate adaptation training, promote microfinance and insurance schemes, and enhance disaster preparedness. Policymakers must integrate climate and food security priorities into development plans, ensure sustainable climate financing, and align actions with the National Climate Change Policy (2016) and Vision 2030. These measures will enhance household food security, reduce vulnerability, and promote sustainable livelihoods amid changing climatic conditions.

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