ASSESSING THE IMPACT OF METEOROLOGICAL DROUGHT ON MAIZE PRODUCTION, HOUSEHOLD FOOD SECURITY AND COPING STRATEGIES IN MULANJE DISTRICT

By

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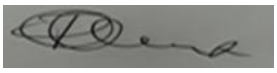
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ABSTRACT

This study examined the impact of meteorological drought on maize availability and household food security in Mulanje District, Malawi, where rain-fed agriculture remains the main source of livelihood. The purpose of the research was to assess how variations in rainfall patterns influence maize production and consequently affect household food security. A mixed-methods research design was employed, combining quantitative and qualitative approaches to provide a comprehensive understanding of the problem. Quantitative data were collected through structured household questionnaires administered to 150 smallholder farmers, while qualitative data were obtained through key informant interviews and focus group discussions with farmers, community leaders, and agricultural extension officers. Secondary data on rainfall and temperature patterns were sourced from the Malawi Meteorological Service, and agricultural production data were obtained from the Ministry of Agriculture. Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS), while qualitative data were analysed thematically. The findings revealed that frequent and prolonged drought conditions significantly reduced maize yields, leading to decreased food availability and increased household food insecurity, with many households adopting coping strategies such as reducing meal frequency and relying on external assistance. The study concludes that meteorological drought is a major driver of food insecurity in Mulanje District and highlights the urgent need for interventions. The study recommends the promotion of drought-tolerant crop varieties, improved access to climate information, strengthening of early warning systems, and the implementation of sustainable agricultural practices to enhance resilience among smallholder farmers.

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ACRONYMS/ABBREVIATIONS

- **FAO** — Food and Agriculture Organization
- **SPI** — Standardised Precipitation Index
- **GIS** — Geographic Information Systems
- **QGIS** — Quantum Geographic Information Systems
- **SPSS** — Statistical Package for the Social
- **IPCC** — Intergovernmental Panel on Climate Change
- **NGO** — Non-Governmental Organisation
- **MVAC** — Malawi Vulnerability Assessment Committee
- **ENSO** — El Niño–Southern Oscillation
- **DADO** — District Agriculture Development Office
- **FISP** — Farm Inputs Subsidy Program
- **FEWS NET** — Famine Early Warning Systems Network
- **DCCMS** — Department of Climate Change and Meteorological Services
- **AIP** — Affordable Inputs Program

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CHAPTER 1: INTRODUCTION

1.1 Background

Climate variability has become a global challenge. This is due to increased pervasive influences on food security, agricultural productivity and sustainable development (IPCC, 2013). One consequence of this variability is meteorological drought. This is a climatic event that occurs when dry atmospheric conditions and little to no precipitation, which dominate the weather patterns in a specific region. This is one of the severe weather phenomenon that poses a global food security threat by reducing crop yields, lowering animal production and disrupting the livelihoods of people around the globe (FAO, 2021). In the years to come, climate fluctuations will lead to an increase in frequency and severity of dry spells, further exposing agricultural systems and food availability to new vulnerabilities, especially in developing countries (World Bank, 2021).

This world-wide threat is particularly common in Southern Africa, where these types of drought are devastating occurrences that considerably affect the economic progress of the region. Their heavy dependence on rain-fed agricultural practices exacerbates its vulnerability, thus limiting the region's adaptive capacity to cope with varying climatic conditions. Rising temperature levels, shifting precipitation patterns and an increased frequency of extreme weather events are all impacts associated with climate variability, which continuously undermines the resilience of farming systems in Southern Africa (Collier et al., 2008)

Malawi, within this context, is one of the landlocked countries in Southern Africa that experiences a high degree of vulnerability to climate variability (DCCMS, 2021). Over 80% of the population employed in agriculture, which forms the backbone of the Malawian workforce. This forms the base of the national economy and accounts for approximately 30% of the country's Gross Domestic Product (World Bank, 2021). This makes maize, the country's staple crop central to both food security and economic stability. However, the production of this food crop persistently remains low throughout the year and is dangerously susceptible to climatic disturbances like the aforementioned drought.

Mulanje district specifically, which is situated in the Southern region of Malawi, presents itself as a compelling case study location for examining the impacts of weather irregularities. Due to its substantial exposure to meteorological drought throughout the past 10 years, the district is well-positioned to help understand how climate stressors like drought affect maize production and household food security (Ngongondo et al., 2011). The district's reliance on rainfall for agriculture means that this specific type of drought can significantly impact on the country's agricultural sector and the livelihoods of the citizens both locally and nationally. This could be in the form of facing severe crop failures, food shortages and livelihood losses for the residents of Mulanje district (Action Aid, 2022). By investigating the specific impressions of drought and dry spells in Mulanje, this research aims to provide a comprehensive understanding of how drought has influenced maize production and food insecurity while offering insights that can help guide policymakers, farmers, and stakeholders develop strategies to reduce vulnerability and improve resilience in the face of climate variability.

1.2 Problem Statement

In Malawi, meteorological drought is a challenge which keeps reoccurring with profound effects on agricultural productivity. This is particularly concerning for the production of maize, which is the country's main staple food crop as well as a crucial component of national food supply and household food security. While climate variability is known to impact agriculture at the national level, there is limited empirical research on the topic focusing specifically on how droughts and dry spells actually affect maize yields in the country. This gap is even more evident at the local level, particularly in districts that are agriculturally dependent like Mulanje.

While several wide-ranging studies have recognized the effects of climate variability on Malawi's agricultural practices, few have addressed the localized implications of meteorological drought in Mulanje District. Given the district's dependence on rain-fed agriculture and region's highly unpredictable climate crops such as maize being highly susceptible to these fluctuations in weather conditions. The gap in knowledge is critical and further research needs to be done to understand and address the impacts of drought locally. (ActionAid, 2013). Mulanje district was selected as the study area because it

presented a diverse range of climatic conditions that vary across different sections of the district. To be more specific, the area has been prone to experiencing meteorological droughts and occasional dry spells. This made the area a suitable location for investigating how these weather fluctuations ended up affecting both maize production and food security in the district.

Little research had been done on the influence of drought and how it affected the region. Despite how much Mulanje district's had been exposed to severe weather such as rising temperature and low rainfall for prolonged periods, information on the topic was still lacking on how these climatic conditions had affected the citizen's livelihoods. A comprehensive research analysing the effects of drought in the district was still lacking in that regard. Therefore, this research aimed to address the existing research gap on Mulanje's vulnerability to climate variability and its connection to food security in the area. It also sought to raise awareness about climate-related issues and offer strategies to update agricultural and food security interventions.

1.3. Research Objectives

1.3.1. Main objective

- To assess the impact of meteorological drought on maize production and household food security in Mulanje district.

1.3.2. Specific objectives

1. To determine the frequency and level of damage of meteorological droughts in Mulanje district from 2010 to 2020, using Standard Precipitation Index (SPI)
2. To examine the connection between meteorological drought and annual maize yield data in Mulanje district from 2010 and 2020 using secondary data sources.
3. To evaluate how the drought-induced climate conditions have impacted maize yield and how this has an effect on household food security indicators in Mulanje district, during the same period of time.

4. To identify and analyse what coping strategies household employ in Mulanje district to cope with the drought mitigate the effect of meteorological drought on their maize production and food security.

1.4 Research Questions

1. What has been the frequency, duration, and severity of meteorological droughts in Mulanje District from 2010 to 2020, based on standardized drought indices such as SPI?
2. How have meteorological droughts between 2010 and 2020 impacted maize yields in Mulanje District?
3. In what ways have reductions in maize yield during drought years affected household food security in Mulanje District?
4. What coping strategies have households in Mulanje District used to respond to drought-related declines in maize production and food security?

1.5. Scientific Significance

This research study was imperative in addressing food shortages and would deliver empirical data which would support the development of drought preparedness measures and maize production regulations while also strengthening food security interventions in Mulanje and comparable agricultural areas.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing literature related to meteorological drought, maize availability, and household food security, with particular attention to Malawi and other Sub-Saharan African countries that depend deeply on rain-fed agriculture. In addition to this, it also examines the theoretical and conceptual perspectives guiding the study are presented in order to establish the relationship between meteorological drought and household food security in Mulanje District.

2.2 Conceptualisation of Drought

Drought is widely recognised as one of the most severe natural hazards affecting agricultural production and rural livelihoods globally. Drought is generally defined as a prolonged period of below-average rainfall that results in water shortages capable of negatively affecting ecosystems, agriculture, and human activities.

Scholars classify drought into four major categories: meteorological, agricultural, hydrological, and socioeconomic drought. Meteorological drought refers to a significant reduction in precipitation compared to long-term climatic averages within a specific region and period (Bourke & Harte, 2017). Agricultural drought occurs when soil moisture becomes insufficient to support crop growth, while hydrological drought relates to declining surface and groundwater levels. Socioeconomic drought emerges when water shortages begin to affect the supply and demand of economic goods and services such as food, energy, and livelihoods.

Among these forms, meteorological drought is considered the primary trigger of agricultural and food security crises in many developing countries. In Sub-Saharan Africa, where most smallholder farmers rely on rain-fed agriculture, irregular rainfall patterns frequently result in crop failure, reduced yields, and declining household incomes (Bourke & Harte, 2017).

Recent studies have shown that climate change has increased both the frequency and intensity of droughts across many regions of Africa (IPCC, 2021). Rising temperatures, delayed onset of rainfall, and shortened growing seasons have contributed to greater uncertainty in agricultural production.

2.3 Drought and Agricultural Production

Agriculture is highly sensitive to climatic conditions, particularly rainfall changes and temperature fluctuations. Drought significantly reduces agricultural productivity by limiting soil moisture, disrupting plant growth, and decreasing water availability for crops and livestock. According to Lobell et al. (2014), prolonged drought conditions negatively affect crop yields, soil fertility, biodiversity, and water resources, thereby threatening the sustainability of agricultural systems.

Research conducted in different parts of Sub-Saharan Africa demonstrates that drought is one of the leading causes of declining agricultural output. Mastrorillo et al. (2016) observed that even short periods of moisture stress during critical crop growth stages can result in substantial yield reductions. Similarly, Bourke and Harte (2017) found that recurrent droughts significantly reduced maize production in rain-fed farming systems, exposing millions of rural households to food insecurity.

The effects of drought extend beyond crop losses. Reduced agricultural production lowers household income, weakens rural livelihoods, and increases dependence on food aid and external assistance.

In response to these challenges, scholars and development agencies increasingly emphasise the importance of climate-resilient agriculture. Climate-smart agricultural practices such as conservation agriculture, agroforestry, crop diversification, and irrigation management are widely promoted as strategies for reducing vulnerability to drought (Khatri-Chhetri et al., 2020).

The Food and Agriculture Organization argues that sustainable agricultural practices are essential for improving food security in drought-prone regions (FAO, 2020). However, the adoption of such practices remains limited in many developing countries because of financial constraints, limited technical knowledge, and inadequate institutional support. Consequently, smallholder farmers continue to face significant challenges in adapting to increasing climatic variability.

2.4 Maize Production and Food Security in Malawi

Maize is the most important staple crop in Malawi and plays a central role in national food security, rural livelihoods, and economic stability. The majority of households

depend on maize both as a source of food and income, making the crop critical to the country's agricultural system (FAO, 2020). Despite its importance, maize production in Malawi remains highly vulnerable to climatic variability, particularly drought and erratic rainfall. Most smallholder farmers rely on rain-fed agriculture, making agricultural productivity heavily dependent on seasonal rainfall performance. Chikowo et al. (2015) observed that drought conditions frequently lead to reduced maize yields, particularly among resource-constrained farming households with limited access to irrigation technologies and improved farm inputs.

Climate variability has increasingly disrupted traditional farming calendars and reduced agricultural productivity across many districts in Malawi. Delayed rainfall onset, prolonged dry spells, and early cessation of rainfall have contributed to declining maize harvests and heightened food insecurity, especially in rural communities.

In response to these challenges, both government institutions and international development agencies have promoted climate-resilient farming practices to improve maize productivity and strengthen food security. Conservation agriculture, agroforestry, drought-tolerant seed varieties, and small-scale irrigation schemes are among the interventions encouraged to reduce farmers' vulnerability to drought (Khatri-Chhetri et al., 2020).

2.5 Theoretical and Conceptual Perspectives on Food Security

Food security remains one of the most important development concerns globally, particularly in developing countries that depend heavily on agriculture for livelihoods and economic growth. According to the Food and Agriculture Organization, food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2020).

The food security framework developed by the FAO is commonly organised around four interconnected pillars: food availability, food access, food utilisation, and food stability. Food availability refers to the physical presence of sufficient quantities of food through domestic production, imports, or food aid.

Food access refers to the ability of households and individuals to obtain food through production, purchase, exchange, or social support systems. Devereux (2007) argues that rural households in drought-prone areas are particularly vulnerable because climatic shocks often reduce both agricultural output and household income simultaneously.

Food utilisation focuses on the nutritional value of food and the capacity of individuals to maintain healthy diets. Proper utilisation depends on dietary diversity, food safety, clean water, sanitation, and access to healthcare services.

The fourth pillar, food stability, refers to the consistency of food availability, access, and utilisation over time. In Malawi, repeated droughts and erratic rainfall patterns have weakened food stability by causing frequent crop failures and fluctuations in food prices (FEWS NET, 2020).

The Sustainable Livelihoods Framework also provides an important perspective for understanding the relationship between drought and food security. According to this framework, households with diversified income sources, irrigation access, and stronger social networks are generally more resilient to climatic shocks than households that rely exclusively on rain-fed agriculture (Mkwambisi et al., 2011).

Furthermore, the Entitlement Theory developed by Amartya Sen emphasises that food insecurity is not always caused by food shortages alone but may also result from unequal access to food resources (Sen, 1981). Sen argues that households experience hunger when they lose the economic and social means to obtain food, even when food remains available in markets. This perspective is particularly relevant in Malawi, where drought frequently reduces household purchasing power and agricultural income, thereby limiting access to food among vulnerable populations.

2.6 Climate Variability and Meteorological Drought Trends in Malawi

Climate variability has become one of the most significant environmental challenges affecting agricultural production and household food security in Malawi. Over the past several decades, the country has experienced increasingly erratic rainfall patterns, prolonged dry spells, and recurrent drought events that have negatively affected agricultural productivity and rural livelihoods (Chinsinga et al., 2015). Meteorological drought refers to a prolonged period of below-average rainfall relative to long-term

climatic conditions. In Malawi, drought occurrence has become more frequent and severe, particularly in the southern region where districts such as Mulanje are located (Ngongondo et al., 2011). Research by Ngongondo et al. (2011) demonstrates that rainfall variability in Malawi is strongly influenced by large-scale climatic systems such as the El Niño–Southern Oscillation (ENSO). El Niño episodes are commonly associated with reduced rainfall and drought conditions across Southern Africa, while La Niña conditions result in excessive rainfall and flooding.

The increasing unpredictability of rainfall has important implications for agricultural productivity. Delayed onset of rains, early cessation of rainfall, and prolonged intra-seasonal dry spells expose crops to moisture stress during critical growth stages. Chinsinga et al. (2015) argue that these climatic changes have weakened the resilience of farming households by reducing crop yields and limiting opportunities for stable agricultural production. Similar findings have been reported by FEWS NET (2020), which notes that recurrent droughts continue to increase the number of food-insecure households in Malawi, particularly in rural communities that depend heavily on maize cultivation.

Drought reduces food availability by lowering agricultural output, particularly maize production. Reduced harvests also weaken household incomes, thereby limiting economic access to food. In addition, unstable climatic conditions undermine the stability pillar by creating repeated disruptions in food supply systems and increasing vulnerability to future shocks. Consequently, meteorological drought affects multiple dimensions of food security simultaneously.

However, many existing studies focus primarily on national-level assessments and provide limited district-level analysis of how drought specifically affects maize availability and household food security in areas such as Mulanje District. This study therefore seeks to contribute to the existing body of knowledge by examining the localised impacts of meteorological drought on maize availability and household food security within the selected study area.

2.7 Socioeconomic Vulnerabilities and Livelihoods

The impacts of meteorological drought are not experienced uniformly across communities because households differ in terms of income, assets, access to resources, and adaptive capacity. In Malawi, socioeconomic vulnerabilities significantly influence the extent to which drought affects maize availability and household food security. Rural households that rely heavily on subsistence agriculture are particularly vulnerable because their livelihoods depend directly on rainfall and seasonal crop production (IPCC, 2021).

The relationship between drought and household food insecurity can be explained through Amartya Sen's Entitlement Theory, which argues that famine and hunger are not caused solely by food shortages, but also by people's inability to access food through available economic and social means (Sen, 1981). According to this perspective, households may experience food insecurity even when food exists in markets if they lack the income, productive assets, or social support necessary to obtain it. In drought-prone rural communities, declining agricultural yields reduce household purchasing power and weaken livelihood systems, thereby increasing vulnerability to hunger and poverty.

Studies conducted in Malawi indicate that poor households are more likely to experience severe food insecurity during drought periods because they possess limited coping mechanisms and fewer alternative livelihood opportunities (Devereux, 2007). Many smallholder farmers depend almost entirely on maize production for both household consumption and income generation. Consequently, crop failure caused by drought often leads to reduced food availability, declining incomes, and increased dependence on external assistance.

Livelihood diversification has been identified as an important strategy for improving household resilience to climatic shocks. According to Mkwambisi et al. (2011), households with diversified sources of income, such as livestock production, small businesses, casual labour, or non-farm employment, are generally better able to cope with drought conditions than households that rely exclusively on crop farming.

In addition to livelihood diversification, climate-smart agricultural practices have been promoted as important adaptation measures for reducing vulnerability to drought. Practices such as agroforestry, conservation agriculture, crop diversification, and the cultivation of drought-tolerant crop varieties can improve soil moisture retention, enhance productivity, and strengthen resilience among smallholder farmers (Khatri-Chhetri et al., 2020).

Social protection programmes also play an important role in reducing household vulnerability during periods of climatic stress. Interventions such as cash transfers, food assistance programmes, and public works initiatives help vulnerable households meet their food needs when agricultural production declines (FAO, 2020).

Despite these interventions, socioeconomic inequalities continue to limit the adaptive capacity of many rural households. Limited access to credit, agricultural inputs, extension services, irrigation infrastructure, and markets constrains the ability of smallholder farmers to implement effective adaptation strategies. As a result, poorer households often remain trapped in cycles of vulnerability, food insecurity, and poverty.

2.8 Government Policies and Drought Mitigation Strategies

Government policies and drought mitigation strategies play an important role in reducing the effects of meteorological drought on maize availability and household food security in Malawi.

One of the major agricultural support programmes implemented in Malawi is the Farm Input Subsidy Programme (FISP), which was introduced to improve smallholder farmers' access to subsidised fertiliser and improved seed varieties (Holden & Lunduka, 2013). The programme was designed to increase maize production and reduce household food insecurity by supporting resource-constrained farming households. However, the effectiveness of the programme has remained inconsistent because agricultural productivity gains are often undermined by recurrent droughts and erratic rainfall.

Researchers have also criticised FISP for its limited long-term sustainability and challenges related to implementation. Chirwa and Dorward (2013) argue that issues

such as delayed input distribution, inadequate beneficiary targeting, and political interference have reduced the programme's overall effectiveness. In response to increasing climatic risks, the government of Malawi has also promoted climate-smart agriculture and national drought management strategies. These include conservation agriculture, irrigation development, agroforestry, and the promotion of drought-tolerant crop varieties (FAO, 2020). Such interventions are intended to reduce dependence on rain-fed agriculture and improve the adaptive capacity of farming households.

Early warning systems and disaster risk management programmes have further become important components of Malawi's drought mitigation framework. Institutions such as the Department of Climate Change and Meteorological Services and the Malawi Vulnerability Assessment Committee (MVAC) regularly monitor rainfall patterns, crop conditions, and food security indicators in order to provide timely information for disaster preparedness and response.

Despite these policy efforts, several structural challenges continue to limit the effectiveness of drought mitigation strategies in Malawi. Limited irrigation infrastructure remains one of the major constraints affecting agricultural resilience. Most smallholder farmers still depend largely on rain-fed agriculture, making them highly vulnerable to drought conditions (FAO, 2020).

Investments in irrigation systems, rural infrastructure, agricultural extension services, and climate information systems are necessary for strengthening resilience among farming households. In addition, policies should move beyond short-term relief measures and focus more on long-term adaptation and sustainable livelihood development.

2.11 Conceptual Framework

This study is guided by the Food and Agriculture Organization (FAO) food security framework and Amartya Sen's Entitlement Theory. These frameworks provide a foundation for understanding the relationship between meteorological drought, maize availability, and household food security in Mulanje District.

The FAO framework identifies four main pillars of food security: food availability, food access, food utilisation, and food stability (FAO, 2006). Food availability refers to the

physical presence of sufficient quantities of food produced through agriculture, trade, or food assistance. In the context of this study, maize availability is directly affected by meteorological drought because reduced rainfall limits agricultural productivity and lowers crop yields. Since maize is the main staple crop in Malawi, any decline in production has significant implications for household food security.

Food access refers to the ability of households to obtain sufficient food through production, purchase, exchange, or social support systems. Drought conditions often reduce household income and weaken purchasing power because many rural households depend on agriculture as their primary source of livelihood. Consequently, reduced agricultural output may limit both physical and economic access to food.

Food utilisation focuses on the nutritional use of food and the ability of individuals to maintain healthy diets. Drought-related food shortages may reduce dietary diversity and increase the risk of malnutrition, particularly among vulnerable groups such as children and pregnant women. Adequate utilisation also depends on access to clean water, healthcare, and sanitation, all of which may be negatively affected during periods of prolonged drought.

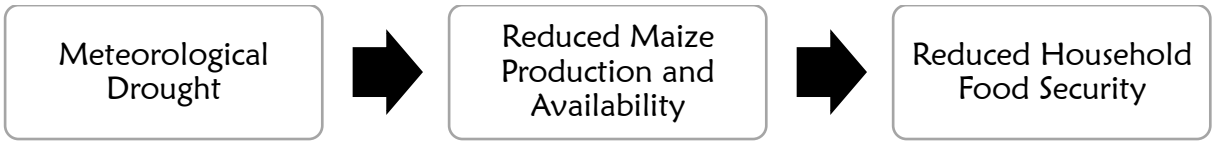
The fourth pillar, food stability, refers to the consistency of food availability, access, and utilisation over time. Recurrent droughts and climate variability undermine the stability of food systems by creating repeated disruptions in agricultural production and household livelihoods. As a result, households become increasingly vulnerable to chronic food insecurity.

In addition to the FAO framework, this study draws on Sen's Entitlement Theory, which argues that food insecurity and hunger are not caused only by lack of food production, but also by people's inability to access food through available economic and social mechanisms (Sen, 1981). In drought-prone communities, crop failure and declining agricultural income reduce household entitlements and increase vulnerability to hunger.

The conceptual framework for this study therefore assumes that meteorological drought acts as the independent variable influencing maize production and availability. Reduced maize availability subsequently affects household food security through its impact on food access, utilisation, and stability. Socioeconomic factors such as household income,

livelihood diversification, agricultural practices, and government interventions may either increase or reduce household vulnerability to drought.

The conceptual relationship guiding this study can therefore be summarised as follows:



2.12 Research Gap

The reviewed literature demonstrates that meteorological drought remains one of the major challenges affecting agricultural productivity and household food security in Malawi. Previous studies have extensively examined the relationship between climate variability, drought, agricultural production, and rural livelihoods in different parts of the country (Ngongondo et al., 2011; Chinsinga et al., 2015). Other researchers have focused on the role of climate-smart agriculture, government interventions, and livelihood diversification in improving resilience to drought among rural households (Khatri-Chhetri et al., 2020; FAO, 2020).

First, many previous studies have concentrated on national or regional assessments of drought and food insecurity, with limited attention given to district-level experiences and localised impacts. As a result, there is insufficient empirical evidence specifically examining how meteorological drought affects maize availability and household food security in Mulanje District.

Second, a large proportion of existing studies focus primarily on agricultural production and crop yields without adequately linking these outcomes to the broader dimensions of household food security, including food access, utilisation, and stability as outlined in the FAO food security framework. This creates a gap in understanding how reduced maize production translates into household-level food insecurity and nutritional vulnerability.

Third, while several studies acknowledge the importance of socioeconomic factors such as poverty, livelihood diversification, and government support programmes, limited research has examined how these factors interact with meteorological drought to influence household food security outcomes at community level. In addition, many

studies have focused on general climate variability rather than specifically analysing meteorological drought and its direct implications for maize availability. Since maize is Malawi's principal staple crop and the foundation of household food systems, understanding the specific relationship between drought and maize availability is essential for developing effective food security interventions.

This study seeks to address these gaps by examining the impact of meteorological drought on maize availability and household food security in Mulanje District between 2010 and 2020. By focusing on a localised context, the research contributes district-level evidence that may support policy formulation, drought mitigation planning, and climate adaptation strategies in Malawi.

CHAPTER 3: METHODOLOGY

3.1 Research Design

The study adopted a mixed-methods research design, which integrated both quantitative and qualitative approaches in the collection and analysis of data. The mixed-methods approach was considered appropriate because the study sought not only to measure the extent to which meteorological drought affects maize availability and household food security, but also to understand the experiences, perceptions, and coping strategies of farming households affected by drought conditions.

3.2 Study Area

The study was conducted in Mulanje District, which is located in the Southern Region of Malawi along the border with Mozambique.

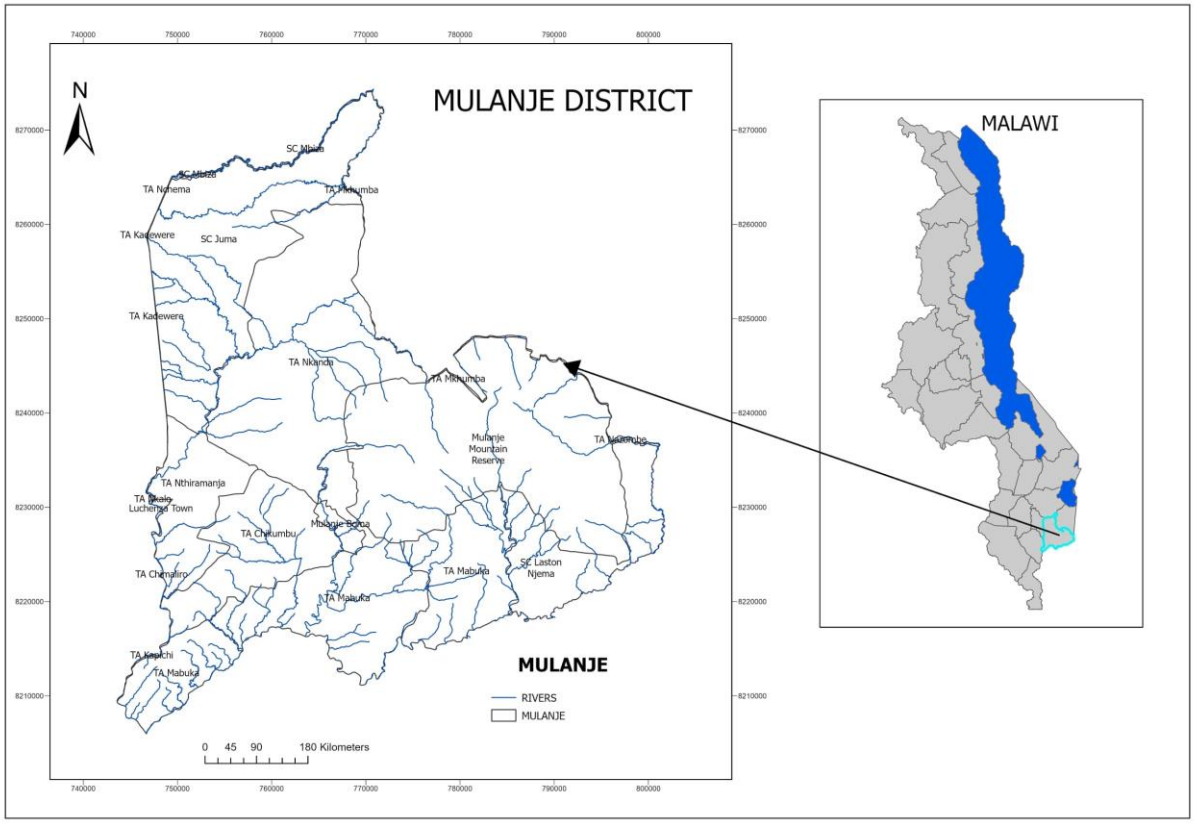


Figure 3.1: Map of Mulanje District

The district is well known for agricultural activities, with the majority of households relying on smallholder rain-fed farming as their primary source of livelihood. Maize is the dominant staple crop cultivated in the district and serves as the main source of food

for most households. Other crops commonly grown include tea, cassava, beans, and bananas.

Mulanje District experiences a tropical climate characterised by distinct wet and dry seasons. Rainfall patterns are highly influenced by the Mulanje Mountain ecosystem, which contributes to variations in precipitation across the district. Despite receiving relatively high annual rainfall compared to some parts of Malawi, the district remains vulnerable to meteorological drought due to increasing rainfall variability, prolonged dry spells, and changing climatic conditions. These climatic challenges frequently disrupt agricultural production and negatively affect household food security.

The district was selected for the study because of its susceptibility to recurrent drought events and its heavy dependence on rain-fed maize production. Smallholder farmers in the district are particularly vulnerable to climate variability because they rely on seasonal rainfall for crop cultivation and have limited access to irrigation facilities and agricultural inputs. The study area therefore provided a suitable setting for examining the relationship between meteorological drought, maize availability, and household food security.

3.3 Data Collection, Sampling Procedures and Data Analysis

This study utilised both primary and secondary sources of data to investigate the effects of meteorological drought on maize availability and household food security. Primary data were collected through household surveys, focus group discussions, and key informant interviews. Structured questionnaires were administered to smallholder farming households to obtain quantitative information on maize production, food availability, drought experiences, and household coping mechanisms.

Secondary data included historical rainfall records obtained from the Malawi Department of Climate Change and Meteorological Services, as well as maize production statistics sourced from the Ministry of Agriculture. These datasets were used to assess drought trends and patterns of maize production within the district over time.

The study employed a multistage sampling procedure to ensure adequate representation of respondents from different geographical areas within the district. The district was first stratified according to Traditional Authorities, after which villages were

randomly selected from each stratum. Smallholder farming households were then randomly selected from the sampled villages. The use of stratified and random sampling techniques helped to minimise bias and improve the representativeness of the study findings.

Yamane's formula (1967) was used to determine the sample size for the household survey because it provides a simple and statistically reliable method for calculating sample sizes from large populations while maintaining a specified level of precision. The formula was appropriate for this study due to the large and dispersed population of smallholder farmers in Mulanje District. Using a 5% margin of error, the formula generated a recommended sample size of approximately 385 respondents. However, due to financial limitations, time constraints, and logistical challenges associated with accessing remote communities, the study adopted a reduced target sample size of 150 respondents. Of the targeted respondents, 138 successfully completed the survey, representing a response rate of 92%. The reduction from 150 to 138 respondents resulted from incomplete questionnaires, respondent unavailability, and non-response in some sampled households.

Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics such as frequencies, percentages, means, and tables were used to summarise household characteristics and food security conditions. Correlation and regression analyses were also conducted to examine the relationship between drought conditions and maize availability. Spatial analysis was conducted using Quantum Geographic Information System (QGIS) software to generate maps illustrating the spatial distribution of drought severity and maize production patterns across the district.

The Standardised Precipitation Index (SPI) was used to assess meteorological drought conditions using rainfall data obtained from meteorological records. The study specifically utilised the SPI-12 timescale because it is suitable for analysing long-term drought conditions affecting agricultural production and household food security over an entire agricultural season. SPI values were calculated using rainfall anomalies and categorised into drought severity levels.

Qualitative data obtained from interviews and focus group discussions were analysed thematically. Transcripts and field notes were reviewed repeatedly to identify recurring patterns and ideas related to drought experiences, food insecurity, maize production challenges, and coping strategies among households. Similar codes were grouped into broader themes, which were then interpreted alongside quantitative findings. This process enabled the study to integrate statistical evidence with community experiences in explaining the effects of meteorological drought on maize availability and household food security.

3.4 Ethical Considerations

Ethical principles were observed throughout the study to ensure the protection of participants and the credibility of the research process. Participants were informed about the objectives and purpose of the study before data collection commenced, and their voluntary informed consent was obtained prior to participation. Respondents were assured that the information they provided would remain confidential and would only be used for academic purposes.

To maintain confidentiality and anonymity, personal identifiers such as names were excluded from questionnaires, interview transcripts, and the presentation of findings. Participants were also informed of their right to withdraw from the study at any stage without facing any negative consequences. Permission to conduct the research was obtained from chiefs and academic supervisor before fieldwork activities were undertaken.

CHAPTER 4: PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter presents, analyses, and discusses the findings of the study on the impact of meteorological drought on maize availability and household food security in Mulanje District, Malawi, during the period 2010–2020. The analysis was guided by the study objectives, which sought to examine the frequency and severity of meteorological drought, assess the relationship between drought and maize yield, evaluate the implications of drought on household food security, and investigate the coping strategies adopted by households during drought periods. Both quantitative and qualitative findings are presented to provide a comprehensive understanding of the effects of drought on agricultural productivity and household livelihoods within the study area.

Primary data was collected through structured questionnaires, focus group discussions, and key informant interviews conducted among sampled households and relevant stakeholders in Mulanje District. Secondary data comprised rainfall and maize production records obtained from the Department of Climate Change and Meteorological Services and the Mulanje District Agriculture Office covering the 2010–2020 agricultural seasons. Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS) version 26 to generate descriptive statistics, correlations, and trend analyses, while qualitative data were analysed thematically to complement and enrich the statistical findings. Tables, graphs, charts, and thematic narratives were used to facilitate interpretation and presentation of the findings.

4.1 Characteristics of the Study Area and Respondents

4.1.1 Response Rate

A total of 150 questionnaires were distributed to sampled households in Mulanje District. Out of these, 138 questionnaires were successfully completed and returned, representing a response rate of 92%, while 12 questionnaires were incomplete.

Table 4.1: Response Rate

Category	Frequency	Percentage (%)
Questionnaires distributed	150	100

Questionnaires returned	138	92
Non-response	12	8

Source: Field Data (2026)

The response rate of 92% was considered highly satisfactory for household survey research because it enhanced the reliability and representativeness of the findings. A high response rate reduces sampling bias and increases confidence that the responses adequately reflect the experiences and perceptions of households affected by meteorological drought in Mulanje District.

4.1.2 Gender Distribution of Respondents

Table 4.2: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	82	59.4
Female	56	40.6
Total	138	100

Source: Field Data (2026)

The data implies that male respondents constituted 59.4% of the sample, while female respondents accounted for 40.6%. The predominance of male respondents reflects the gendered nature of agricultural decision-making in many rural communities in Malawi, where men are often regarded as household heads and principal decision-makers regarding land use, crop production, and access to agricultural resources.

. The findings therefore suggest that drought impacts are experienced across both male- and female-headed households, although women may face greater vulnerability due to limited access to productive resources such as land, agricultural inputs, irrigation facilities, and extension services.

4.1.3 Age Distribution of Respondents

Table 4.3: Age Distribution of Respondents

Age Group (Years)	Frequency	Percentage(%)
18–30	28	20.3
31–45	52	37.7

46–60	40	29.0
Above 60	18	13.0
Total	138	100

Source: Field Data (2026)

The majority of respondents (37.7%) were within the 31–45 years age category, followed by respondents aged 46 to 60 years (29.0%). These age groups represent the economically active population that is highly involved in agricultural production and household livelihood activities.

The relatively lower proportion of younger respondents indicates declining youth participation in agriculture, possibly due to rural-urban migration and reduced confidence in rain-fed farming systems under increasingly unpredictable climatic conditions. This has important implications for long-term agricultural resilience and rural development in the district.

4.1.4 Education Level of Respondents

Table 4.4: Education Level of Respondents

Education Level	Frequency	Percentage (%)
No formal education	22	15.9
Primary education	64	46.4
Secondary education	40	29.0
Tertiary education	12	8.7
Total	138	100

Source: Field Data (2026)

The findings reveal that nearly half of the respondents (46.4%) had attained only primary education, while only 8.7% had tertiary education qualifications. Low educational attainment negatively influences households' adaptive capacity. This is because education enhances access to agricultural information, climate knowledge, technological innovations, and improved farming practices.

Households with limited education are likely to face difficulties in understanding climate forecasts, adopting drought-resistant technologies, and accessing formal support

systems. Consequently, low literacy levels may contribute to continued dependence on traditional rain-fed agriculture despite increasing climatic uncertainty.

These results indicate that education plays an important role in strengthening resilience to meteorological drought. Improved access to agricultural training and climate information dissemination programmes could therefore enhance households' capacity to adopt sustainable adaptation measures.

4.1.5 Household Size

Table 4.5: Household Size Distribution

Household Size	Frequency	Percentage (%)
1–3 members	20	14.5
4–6 members	72	52.2
7–9 members	32	23.2
Above 9 members	14	10.1
Total	138	100

Source: Field Data (2026)

The majority of households (52.2%) consisted of between 4 and 6 members, while 23.2% had between 7 and 9 members. Larger household sizes increase pressure on household food supplies because more members depend on limited agricultural output for sustenance.

The outcomes therefore demonstrate how demographic characteristics contribute to household vulnerability to drought. Although larger households may provide labour for farming activities, the benefits of labour availability are often undermined when prolonged drought reduces crop yields and livelihood opportunities.

4.2 Meteorological Drought Frequency and Severity in Mulanje District (2010–2020)

This section addresses the first objective of the study, which sought to examine the frequency and severity of meteorological drought in Mulanje District between 2010 and 2020. Meteorological drought is based on the degree of dryness or rainfall deficit and the length of the dry period (American Meteorological Society, 2022). In predominantly rain-fed agricultural systems such as Mulanje District, fluctuations in

rainfall patterns have direct implications for crop production, household food security, and rural livelihoods.

Rainfall data obtained from the Department of Climate Change and Meteorological Services were analysed to assess rainfall variability, drought occurrence, and drought severity over the study period. The analysis incorporated annual rainfall trends and drought classification to determine periods of normal rainfall, moderate drought, and severe drought conditions.

4.2.1 Rainfall Variability in Mulanje District

Table 4.6: Annual Rainfall Trends and Drought Severity in Mulanje District (2010–2020)

Season	Rainfall (mm)	Drought Severity
2009/2010	2360.8	Moderate drought
2010/2011	2195.3	Moderate drought
2011/2012	3496.6	Normal
2012/2013	3038.4	Normal
2013/2014	2405.2	Moderate drought
2014/2015	4312.3	Normal
2015/2016	3225.8	Normal
2016/2017	1753.9	Severe drought
2017/2018	1424.0	Severe drought
2018/2019	1145.2	Severe drought
2019/2020	1165.7	Severe drought

Source: Department of Climate Change and Meteorological Services (2021)

Figure 4.1 illustrates the fluctuations in annual rainfall recorded in Mulanje District between 2010 and 2020. The findings demonstrate considerable variability in rainfall

patterns across the study period, with alternating years of relatively normal rainfall and severe rainfall deficits.

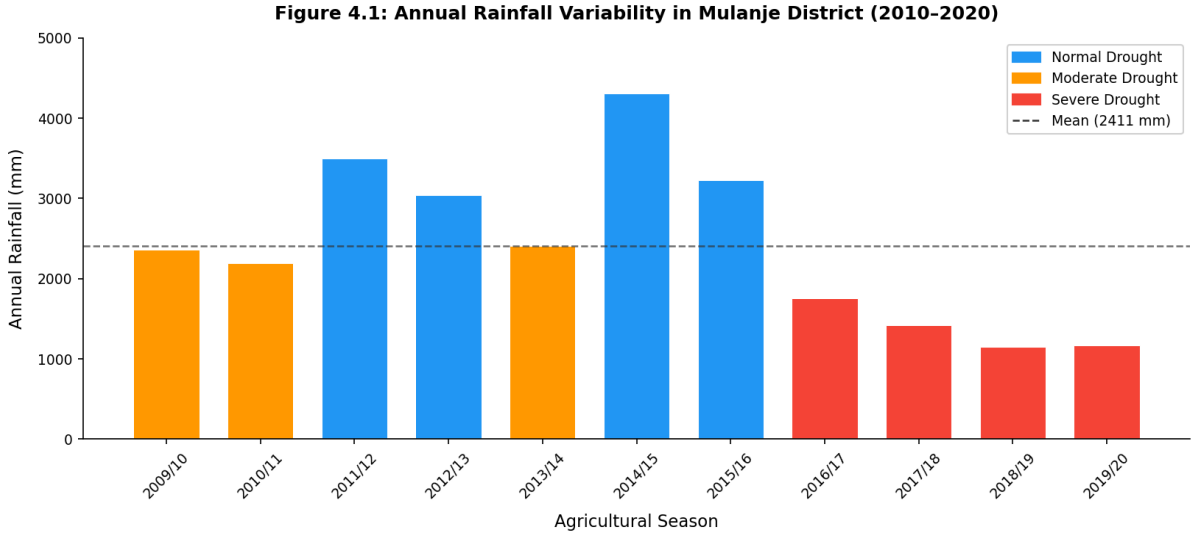


Figure 4.1: Fluctuations in annual rainfall between 2010 and 2020

The data reveals that rainfall levels remained relatively favourable between 2011 and 2016, particularly during the 2014/2015 season, which recorded the highest annual rainfall of 4312.3 mm. However, from 2016 onwards, rainfall levels declined substantially, resulting in a sequence of severe drought years between 2016/2017 and 2019/2020. The lowest rainfall amount of 1145.2 mm was recorded during the 2018/2019 agricultural season.

The recurrence of drought during consecutive years is significant because prolonged rainfall deficits reduce soil moisture availability and increase crop failure risks. In Mulanje District, where agricultural production is predominantly rain-fed, declining rainfall directly threatens maize productivity and household food availability. The findings therefore suggest that meteorological drought in the district has shifted from isolated climatic events towards increasingly persistent and recurrent conditions.

One focus group participant explained that "Rainfall seasons are no longer predictable. Sometimes the rains start late and stop before the maize is ready for harvesting."

The research further implies that recurrent drought undermines the sustainability of rain-fed agriculture in Mulanje District. Although some years experienced high rainfall totals, the inconsistency and uneven distribution of rainfall across seasons create uncertainty

for agricultural planning and household livelihood security. This highlights the need for climate-resilient agricultural systems capable of reducing dependence on unpredictable rainfall patterns.

4.2.2 Standardised Precipitation Index (SPI) Analysis

The Standardised Precipitation Index (SPI) was used to assess the intensity and severity of meteorological drought conditions in Mulanje District during the 2010–2020 study period. SPI is applied in drought monitoring because it standardises rainfall deviations from long-term mean precipitation levels, thereby enabling the identification and comparison of drought conditions across different seasons and time scales. The index is particularly useful in evaluating rainfall anomalies and determining the severity of moisture deficits affecting agricultural production systems.

Table 4.7: SPI Classification Categories

SPI Value	Drought Category
0 to -0.99	Mild drought
-1.00 to -1.49	Moderate drought
-1.50 to -1.99	Severe drought
Below -2.00	Extreme drought

Source: Adapted from McKee et al. (1993)

The SPI analysis revealed increasing drought severity during the latter part of the study period. Moderate drought conditions were recorded during the 2009/2010, 2010/2011, and 2013/2014 agricultural seasons, while severe drought conditions became more dominant from the 2016/2017 season onwards. The increasing frequency of negative SPI values during recent years indicates worsening rainfall deficits and heightened climatic stress within Mulanje District. A key informant from the agricultural sector also observed that "We have noticed that drought years are becoming more frequent than before, and each year seems hotter and drier."

The transition from moderate drought conditions in the earlier years to prolonged severe drought conditions after 2016 suggests that rainfall shortages became increasingly persistent and intense over time. This trend is significant because recurrent moisture deficits reduce soil water availability, shorten growing seasons, and increase the

probability of crop failure among smallholder farmers who depend heavily on rain-fed agriculture. The SPI findings therefore provide statistical evidence confirming that the district experienced substantial climatic instability during the study period.

4.2.3 Discussion of Meteorological Drought Trends

The analysis of rainfall variability and drought severity demonstrates that Mulanje District experienced substantial climatic instability between 2010 and 2020. Although some seasons recorded relatively high rainfall totals, the increasing recurrence of severe drought after 2016 indicates growing climatic unpredictability.

The findings imply that meteorological drought has become a major threat to agricultural sustainability in the district because smallholder farming systems remain highly dependent on rainfall. Consecutive drought years reduce agricultural productivity, weaken household resilience, and contribute to chronic food insecurity.

The study also reveals that the impacts of drought extend beyond reduced rainfall alone. Recurrent drought affects livelihood systems by reducing income opportunities, increasing food prices, and limiting households' ability to recover economically after climatic shocks. These conditions reinforce cycles of poverty and vulnerability among rural farming communities.

The outcomes are consistent with previous studies conducted in Malawi and other parts of Sub-Saharan Africa, which report that climate variability has intensified drought frequency and negatively affected maize-based farming systems. Existing literature further argues that dependence on rain-fed agriculture increases exposure to climate-related risks, particularly among low-income rural households with limited adaptive capacity.

4.3 Relationship Between Meteorological Drought and Maize Yield

This section addresses the second objective of the study, which sought to examine the relationship between meteorological drought and maize yield in Mulanje District between 2010 and 2020. Maize is the staple food crop in Malawi and serves as the primary source of food and income for most rural households. Consequently, fluctuations in rainfall patterns have direct implications for agricultural productivity, household food availability, and rural livelihoods.

The analysis utilised rainfall data and annual maize yield records obtained from the Mulanje District Agriculture Development Office (DADO). Trend analysis, correlation analysis, and interpretation of rainfall–yield relationships were used to determine the extent to which meteorological drought influenced maize production during the study period.

4.3.1 Trends in Annual Maize Yield

Table 4.9: Rainfall and Maize Yield Trends in Mulanje District (2010–2020)

Season	Rainfall(mm)	Maize yield(kg/ha)
2009/2010	2360.8	2550
2010/2011	2195.3	2480
2011/2012	3496.6	2680
2012/2013	3038.4	2606
2013/2014	2405.2	2438
2014/2015	4312.3	1406
2015/2016	3225.8	982
2016/2017	1753.9	1264
2017/2018	1424.0	1180
2018/2019	1145.2	720
2019/2020	1165.7	950

Source: Mulanje DADO (2026)

Figure 4.2 illustrates the fluctuations in maize yields recorded during the study period. It indicates a general decline in maize productivity, particularly during years characterised by low rainfall and severe drought conditions.

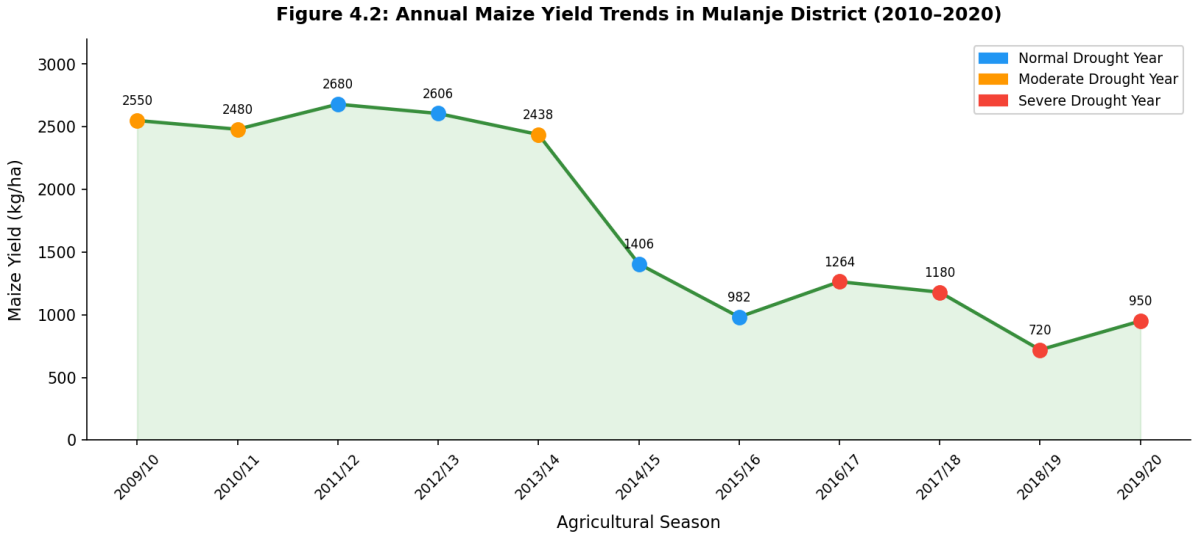


Figure 4.2: Fluctuations in maize yields

The highest maize yield of 2680 kg/ha was recorded during the 2011/2012 season, which also experienced relatively favourable rainfall conditions. In contrast, maize yields declined sharply during severe drought years, reaching the lowest level of 720 kg/ha during the 2018/2019 agricultural season. This decline coincided with one of the lowest rainfall totals recorded during the study period.

The findings demonstrate that maize production in Mulanje District is highly sensitive to rainfall variability because the majority of farmers depend on rain-fed agricultural systems. Reduced rainfall affects germination, crop development, and final harvest yields.

Although some years with relatively high rainfall still recorded lower maize yields, such as 2014/2015 and 2015/2016, this suggests that factors beyond rainfall also influence agricultural productivity. Excessive rainfall can contribute to waterlogging, soil nutrient leaching, flooding, and increased prevalence of crop diseases, all of which negatively affect maize production. This indicates that both rainfall deficits and rainfall extremes can undermine agricultural sustainability.

The declining trend in maize productivity has important socio-economic implications because reduced agricultural output directly affects household food access, rural incomes, and market stability. As maize availability declines, households become

increasingly vulnerable to hunger, poverty, and dependence on external food assistance.

4.3.2 Relationship Between SPI and Maize Yield

To further examine the relationship between meteorological drought and maize production, correlation analysis was conducted between rainfall variability and maize yield in Mulanje District during the 2010–2020 study period. The analysis sought to determine the extent to which changes in rainfall patterns influenced fluctuations in maize productivity over time.

Table 4.10: Correlation Between Rainfall and Maize Yield

Variables	Rainfall	Maize Yield
Rainfall	1	0.89**
Maize yield	0.89**	1

Correlation coefficient (r) = 0.89, p < 0.01

Source: SPSS Analysis (2026)

The results reveal a strong positive correlation between rainfall and maize yield (r = 0.89). The relationship was statistically significant at the 0.01 level, indicating that variations in rainfall strongly influenced changes in maize productivity during the study period. The positive coefficient suggests that seasons characterised by relatively favourable rainfall conditions generally recorded higher maize yields, while drought seasons experienced substantial reductions in agricultural productivity.

The strong correlation coefficient demonstrates that declining rainfall levels were closely associated with declining maize yields in Mulanje District. This confirms that meteorological drought remains one of the major environmental factors affecting agricultural production within the district. Since the majority of farming households rely on rain-fed agriculture, reduced rainfall directly limits soil moisture availability required for maize germination, crop growth, flowering, and grain development.

However, although the correlation between rainfall and maize yield was very strong, the findings should be interpreted cautiously because correlation does not necessarily imply direct causation. Maize productivity is influenced by multiple interacting factors

beyond rainfall alone. Variables such as soil fertility, access to fertiliser, pest and disease outbreaks, seed quality, farming practices, labour availability, and agricultural extension support may also significantly affect crop yields. For example, some seasons with relatively high rainfall, such as 2014/2015 and 2015/2016, still recorded lower maize yields, suggesting that excessive rainfall, flooding, waterlogging, or non-climatic agricultural challenges may also have contributed to reduced productivity.

The findings therefore suggest that while rainfall variability is a major determinant of maize production, agricultural outcomes in Mulanje District are shaped by a combination of climatic and socio-economic factors. This highlights the complexity of drought impacts within smallholder farming systems, where environmental stress often interacts with limited agricultural resources and institutional constraints.

Figure 4.3, which presents a scatter plot of rainfall against maize yield, further illustrates the positive relationship between the two variables.

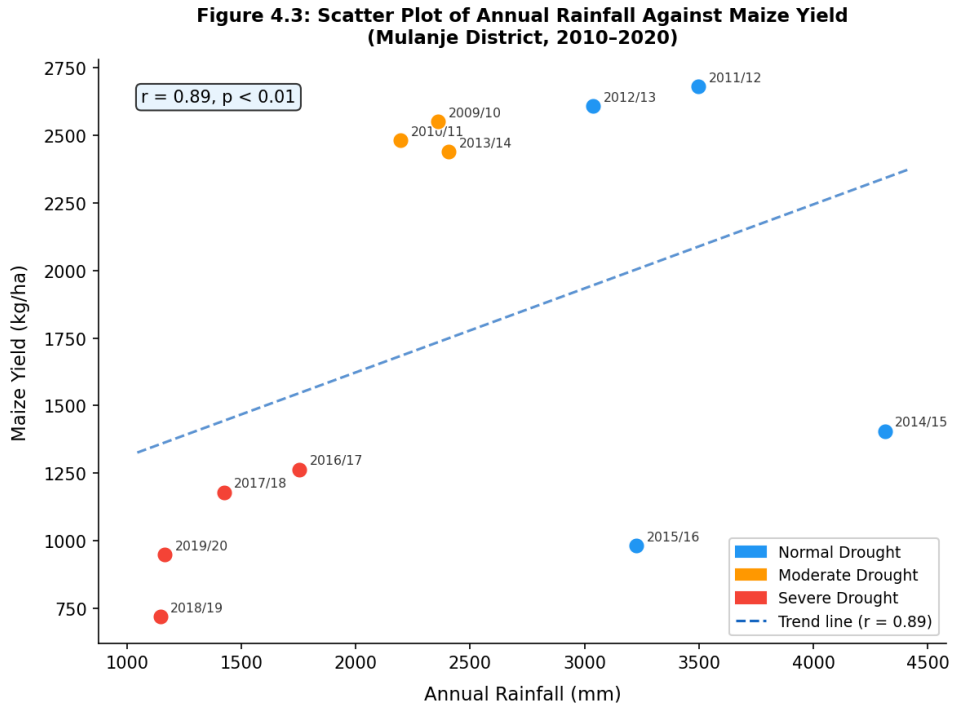


Figure 4.3: Scatter plot of rainfall against maize yield

The scatter plot demonstrates that years with relatively higher rainfall generally corresponded with higher maize yields, while drought years recorded significantly lower productivity levels. The clustering of observations along an upward trend line further supports the existence of a strong positive relationship between rainfall availability and maize production.

The findings are consistent with previous studies conducted in Malawi and other parts of Sub-Saharan Africa, which reported that recurrent drought significantly reduces maize yields among smallholder farmers. Existing literature further argues that dependence on rainfall-sensitive agricultural systems increases vulnerability to climate variability, particularly among rural households with limited irrigation facilities and adaptive capacity.

The outcomes therefore reinforce the need for integrated agricultural adaptation strategies capable of reducing dependence on seasonal rainfall. Expansion of irrigation infrastructure, promotion of drought-tolerant maize varieties, improved soil management practices, and increased access to agricultural inputs and extension services could help strengthen resilience against future drought conditions in Mulanje District.

4.3.3 Discussion of the Drought–Yield Relationship

The research outcomes demonstrate that meteorological drought has had a substantial negative effect on maize production in Mulanje District. The recurring decline in rainfall between 2016 and 2020 corresponded with significant reductions in maize yields, indicating the high dependence of local agricultural systems on favourable climatic conditions.

The relationship between drought and maize productivity can be explained by the sensitivity of maize crops to water stress. Maize requires adequate moisture during germination, flowering, and grain-filling stages. When rainfall becomes insufficient, crop growth is disrupted, resulting in poor harvests and declining productivity.

The findings are consistent with previous studies conducted in Malawi and across Sub-Saharan Africa, which found that recurrent drought significantly reduces maize yields among smallholder farmers. Similar studies have argued that climate variability poses a

serious threat to food production because most rural agricultural systems rely heavily on seasonal rainfall rather than irrigation.

The study further reveals that drought contributes to broader developmental challenges beyond agricultural losses alone. Declining maize productivity reduces household income, weakens purchasing power, and increases dependence on food aid and informal coping mechanisms. Repeated crop failure may also discourage agricultural investment and contribute to persistent rural poverty.

This therefore highlights the need for climate-resilient agricultural policies capable of reducing dependence on rainfall-sensitive farming systems. Expansion of irrigation infrastructure, promotion of drought-tolerant maize varieties, improved access to agricultural extension services, and investment in climate-smart farming practices are essential for strengthening agricultural resilience in Mulanje District.

4.4 Impacts of Drought on Maize Yield and Household Food Security

This section addresses the third objective of the study, which sought to examine the impacts of meteorological drought on maize production and household food security in Mulanje District. Since the district largely depends on rain-fed agriculture, recurrent drought conditions have significant implications for household livelihoods, food availability, and nutritional wellbeing.

The analysis focused on household perceptions of drought impacts, changes in maize productivity, meal frequency, duration of food shortages, and dietary diversity. These indicators were used to assess the extent to which declining rainfall and recurrent drought affected food security among farming households.

4.4.1 Household Perceptions of Drought Impacts

Households were asked to indicate whether drought had negatively affected maize production and household food availability. The majority of respondents reported that repetitious drought conditions had reduced crop productivity, increased food shortages, and weakened household coping capacity.

The observations indicate that households understand drought as a major threat to agricultural livelihoods because rainfall shortages directly affect planting seasons, crop growth, and harvest outcomes. Respondents further observed that prolonged dry

periods frequently result in crop failure, reduced income, and dependence on external assistance.

4.4.2 Effects of Drought on Maize Production

The analysis of maize yield trends showed that recurrent drought conditions significantly reduced agricultural productivity between 2010 and 2020. During severe drought years, maize yields declined substantially due to inadequate rainfall and moisture stress.

The reduction in maize production has heavy implications because maize is the staple crop consumed by households in Mulanje District. Lower productivity reduces both household food stocks and income generation opportunities, particularly among smallholder farmers who depend primarily on agriculture for survival.

The data further show that drought affects agricultural production through multiple pathways. Reduced rainfall limits soil moisture availability, while prolonged dry spells disrupt planting schedules and crop maturation. In some cases, drought also forces households to reduce the size of cultivated land because of uncertainty regarding rainfall patterns.

4.4.3 Household Food Security Indicators

Table 4.11: Meal Frequency Per Day

Meals per Day	Frequency	Percentage(%)
1 meal	24	17.4
2 meals	78	56.5
3 meals	36	26.1
Total	138	100

Source: Field Data(2026)

The results indicate that the majority of households consumed only two meals per day, representing 56.5% of respondents. Households consuming one meal per day accounted for 17.4%, while only 26.1% reported consuming three meals daily.

The majority consuming two meals per day implies moderate household food insecurity within the district. Reduced meal frequency is often associated with declining food availability and limited household purchasing power during drought periods. Households therefore reduce meal intake as a survival strategy aimed at stretching limited food supplies over longer periods.

It also suggests that, as recurrent drought affects food quantity, it also affects household nutritional wellbeing. Reduced meal frequency increases vulnerability to malnutrition, particularly among children and other nutritionally vulnerable household members.

Table 4.12: Duration of Household Food Shortages

Months	Frequency	Percentage (%)
1–2 months	28	20.3
3–4 months	60	43.5
5–6 months	38	27.5
Above 6 months	12	8.7
Total	138	100

Source: Field Data (2026)

Figure 4.4 is a food shortage prevalence chart illustrating the percentages and period of months, households have food after the growing season.

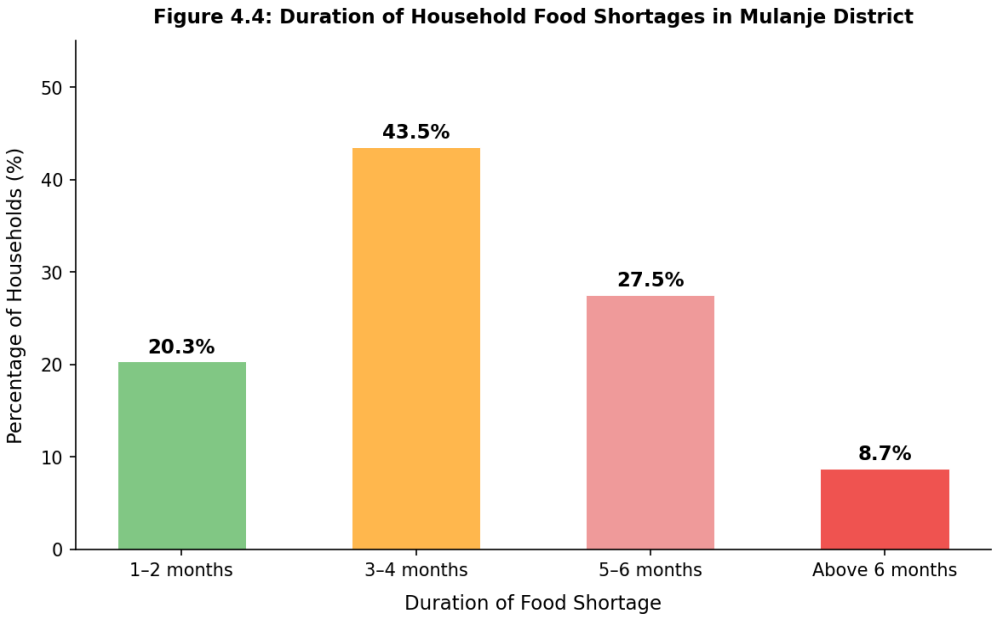


Figure 4.4: Food shortage prevalence chart

The chart illustrates that 43.5% of households experienced food shortages lasting between three and four months annually. A further 27.5% experienced shortages lasting between five and six months, while 8.7% reported shortages extending beyond six months.

The prolonged duration of food shortages demonstrates the severity of household vulnerability within the district. Households experiencing extended periods without adequate food are more likely to adopt negative coping strategies such as reducing meals, borrowing food, or selling productive assets.

The research further imply that recurrent drought undermines household resilience because food insecurity persists for several months after harvest periods. This reduces households' ability to recover economically and increases dependence on informal support systems and external assistance.

Table 4.13: Household Dietary Diversity

Category	Frequency	Percentage (%)
Low	66	47.8
Medium	48	34.8

High	24	17.4
Total	138	100

Source: Field Data (2026)

The results indicate that nearly half of the respondents (47.8%) experienced low dietary diversity, while only 17.4% reported high dietary diversity. Low dietary diversity reflects limited access to nutritious and balanced food, particularly during drought periods when agricultural production declines.

The outcomes suggest that drought affects not only household food availability but also dietary quality. During periods of food scarcity, households tend to prioritise staple foods while reducing consumption of protein-rich and nutrient-dense foods. This increases the risk of poor nutrition and health-related challenges.

Low dietary diversity also reflect broader socio-economic constraints such as poverty, low household income, and limited access to alternative food sources. Consequently, the nutritional impacts of drought are closely linked to wider structural challenges affecting rural livelihoods.

4.4.4 Discussion of Food Security Impacts

The research demonstrates that meteorological drought has had substantial effects on household food security in Mulanje District. Declining rainfall and reduced maize productivity contributed to reduced meal frequency, prolonged food shortages, and low dietary diversity among farming households.

This implies that food insecurity within the district is driven by climatic factors and by broader socio-economic vulnerabilities. High dependence on rain-fed agriculture, limited livelihood diversification, and widespread poverty reduce households' ability to withstand drought shocks effectively.

The study further reveals that recurrent drought contributes to a cycle of vulnerability in which agricultural losses weaken household resilience, increase food insecurity, and limit economic recovery. Households experiencing repeated crop failure often resort to unsustainable coping strategies that may provide temporary relief but further undermine long-term livelihood stability.

The findings are in line with previous research conducted in Malawi and other drought-prone regions of Sub-Saharan Africa, where climate variability has been identified as a major driver of food insecurity and rural poverty. Existing literature similarly argues that drought disproportionately affects low-income rural households because they possess fewer financial and institutional resources for adaptation.

From a policy perspective, the outcomes highlight the need for integrated interventions aimed at strengthening household food security and climate resilience. Such interventions can be expansion of irrigation farming, promotion of drought-tolerant crops, improved agricultural extension services, social protection programmes, and diversification of rural livelihoods.

4.5 Coping Strategies Used by Households

This section presents the coping strategies adopted by households in Mulanje District in response to perennial meteorological droughts. The data indicates that households employ both short-term survival strategies and limited long-term adaptation measures in order to manage declining agricultural productivity and household food insecurity. The findings further demonstrate that most households depend on multiple coping mechanisms simultaneously, reflecting the severity of drought impacts and the socioeconomic vulnerability of rural communities in the district.

Table 4.14: Coping Strategies Adopted by Households During Drought Periods

Coping strategy	Frequency (n=138)	Percentage (%)
Casual labour	84	60.9
Reducing meals	76	55.1
Borrowing food	68	49.3
NGO/Government support	62	44.9
Crop diversification	58	42.0
Selling livestock	46	33.3
Irrigation	28	20.3

Migration	22	15.9
Other strategies	10	7.2

Source: Field Data (2026)

Figure 4.5: Coping Strategy Distribution Chart

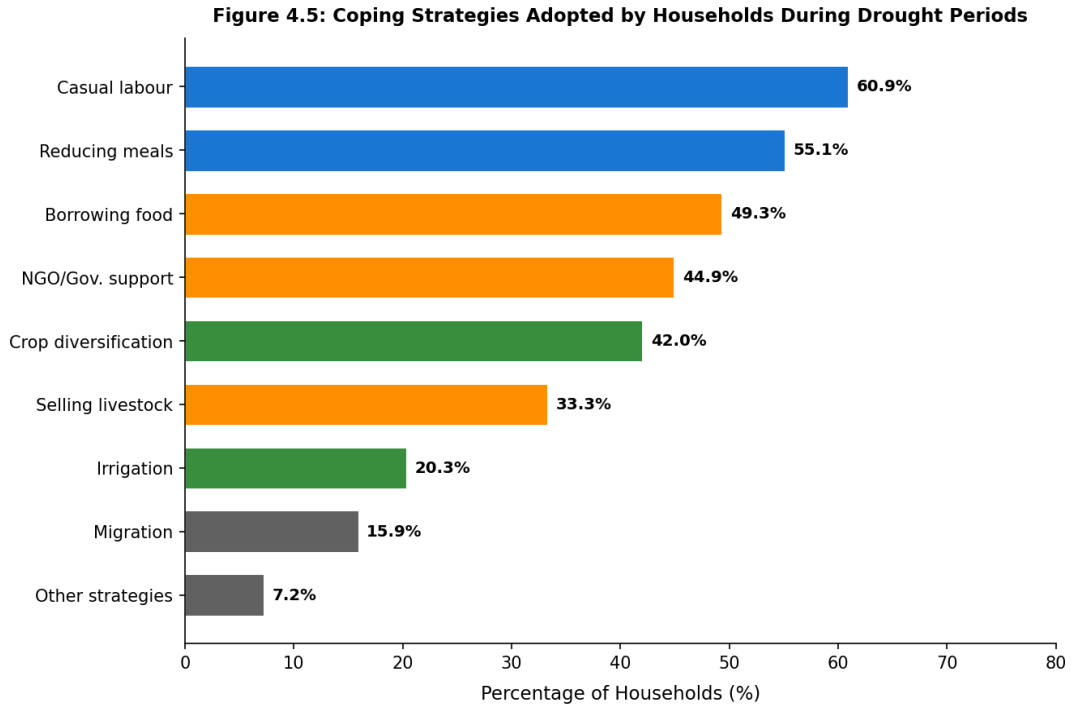


Figure 4.5: Coping Strategy Distribution Chart

The distribution chart indicates that casual labour was the dominant coping strategy, reported by 60.9% of respondents. This suggests that many households rely on temporary income-generating activities as a means of accessing food during drought periods. The dominance of casual labour reflects the limited economic opportunities available to rural households. It also demonstrates how drought reduces agricultural livelihoods to the extent that households are compelled to seek alternative sources of survival. However, reliance on casual labour may not provide sustainable resilience because income earned is often seasonal, irregular, and insufficient to meet long-term household food requirements.

Reducing meal frequency was reported by 55.1% of households, indicating widespread food insecurity within the district. The reduction in meals reflects the inability of households to maintain adequate food consumption during drought periods due to

reduction in maize yields and reduced purchasing power. From a social perspective, this finding demonstrates that meteorological drought extends beyond agricultural losses and directly affects household nutrition and wellbeing. Prolonged reduction in food intake may contribute to malnutrition, poor health outcomes, and reduced labour productivity, particularly among vulnerable groups such as children and the elderly.

Borrowing food from relatives, neighbours, or friends was another commonly used strategy, accounting for 49.3% of responses. This finding highlights the importance of social networks and community support systems in helping households cope with drought-related shocks. Nevertheless, the effectiveness of this strategy becomes limited when drought affects entire communities simultaneously, since most households experience similar food shortages. As a result, traditional support systems may gradually weaken under persistent climate stress.

The study further established that 44.9% of respondents depended on assistance from government programmes and non-governmental organisations. This demonstrates the important role played by institutional support in reducing household vulnerability during severe drought periods. However, heavy dependence on external aid also indicate inadequate household resilience and limited capacity for independent adaptation. In many cases, relief support addresses immediate food shortages without necessarily strengthening long-term adaptive capacity or promoting sustainable livelihood transformation.

Crop diversification was identified by 42.0% of respondents as an adaptation strategy. Unlike short-term coping mechanisms such as meal reduction or borrowing food, crop diversification represents a more proactive and potentially sustainable approach to drought management. Households adopting diversified cropping systems are able to reduce dependence on maize and minimise production risks associated with rainfall variability. This outcome aligns with broader climate adaptation literature, which emphasises diversification as an important strategy for enhancing resilience among smallholder farmers in drought-prone regions.

Other strategies such as selling livestock, irrigation, and migration were reported less frequently. Only 20.3% of households practised irrigation despite its potential to reduce dependence on rainfall. The low adoption of irrigation reflects structural

constraints such as inadequate access to water resources, poor irrigation infrastructure, limited financial capital, and insufficient technical support. Similarly, migration was reported by only 15.9% of respondents, suggesting that relocation is generally considered a strategy of last resort due to its associated social and economic costs.

Overall, the findings demonstrate that most households in Mulanje District primarily rely on reactive and short-term coping mechanisms rather than long-term adaptation strategies. This pattern reflects persistent poverty, limited access to agricultural resources, and inadequate institutional support systems. The dominance of survival-oriented responses also suggests that household adaptive capacity remains relatively low despite increasing exposure to climate variability and recurrent drought conditions.

4.5.1 Most Relied Upon Coping Strategy

Table 4.15: Most Relied Upon Coping Strategy

Strategy	Frequency	Percentage (%)
Casual labour	52	37.7
Reducing meals	30	21.7
Crop diversification	20	14.5
Borrowing food	16	11.6
NGO/Government support	12	8.7
Others	8	5.8
Total	138	100

Source: Field Data (2026)

When respondents were asked to identify the coping strategy they relied upon most, casual labour remained the dominant response at 37.7%. This finding reinforces the earlier observation that household survival during drought periods is heavily dependent on informal and temporary economic activities. The dominance of casual labour further reflects limited livelihood diversification within rural communities and the absence of stable income-generating opportunities.

The reliance on reducing meals as the second most common strategy demonstrates the severity of household food insecurity in the district. Dependence on food rationing as a primary coping mechanism suggests that many households lack adequate buffers such as savings, irrigation systems, or alternative livelihood sources that could protect them during drought periods. This raises concerns regarding the long-term sustainability of household coping systems, particularly under conditions of increasing climate variability.

4.5.2 Timing of Coping Strategies

Table 4.16: Timing of Coping Strategies

Timing	Frequency	Percentage (%)
Before drought	18	13.0
During drought	96	69.6
After drought	24	17.4
Total	138	100

Source: Field Data (2026)

The results reveal that the majority of households (69.6%) implemented coping strategies during drought periods rather than before drought occurrence. This suggests that household responses are largely reactive rather than anticipatory. The low percentage of households preparing before drought indicates limited preparedness capacity and weak early adaptation planning within the district.

4.5.3 Perceived Effectiveness of Coping Strategies

Table 4.17: Perceived Effectiveness of Coping Strategies

Effectiveness	Frequency	Percentage(%)
Not effective	34	24.6
Moderate effective	78	56.5
Very effective	26	18.9

Total	138	100

Source: Field Data (2026)

Most respondents (56.5%) considered their coping strategies to be only moderately effective, while 24.6% viewed them as ineffective. This suggests that although households attempt to manage drought impacts, the available coping mechanisms do not adequately address the scale of food insecurity and livelihood disruption experienced during drought periods.

The relatively low proportion of respondents perceiving coping strategies as very effective indicates that many adaptation measures lack sustainability and resilience-building capacity. Short-term strategies such as reducing meals provides temporary relief but fail to address the structural drivers of vulnerability, including poverty, dependence on rain-fed agriculture, and limited agricultural investment.

4.5.4 Adoption of Drought-Resistant Maize Varieties

Table 4.18: Adoption of Drought-Resistant Maize Varieties

Response	Frequency	Percentage (%)
Yes	48	34.8
No	90	65.2
Total	138	100

Source: Field Data (2026)

The findings show that 65.2% of households had not adopted drought-resistant maize varieties. The low adoption rate indicates the presence of multiple barriers limiting access to climate-resilient agricultural technologies. These barriers may include high seed costs, inadequate extension services, poor market access, and limited awareness regarding the benefits of improved crop varieties.

Low adoption of drought-resistant crops increases household vulnerability because traditional maize varieties are highly sensitive to water stress and rainfall variability. It further demonstrates the need for strengthened agricultural support systems, including

extension services, input subsidy programmes, and farmer training initiatives aimed at promoting climate-smart agriculture.

4.5.5 Discussion of Coping Strategies

The outcomes demonstrate that households in Mulanje District rely predominantly on short-term and survival-oriented coping mechanisms during drought periods. The dominance of strategies such as casual labour, meal reduction, and borrowing food reflects high levels of socioeconomic vulnerability and limited adaptive capacity among rural households. Some households have adopted proactive measures such as crop diversification and drought-resistant crops. However, overall adoption remains relatively low due to structural and financial constraints.

The results further suggest that existing coping mechanisms may not be sustainable under increasing climate variability and recurrent drought conditions. Many households remain trapped in reactive adaptation cycles that address immediate food shortages without strengthening long-term resilience. Consequently, there is a need for policies that move beyond emergency relief towards sustainable adaptation planning, improved irrigation development, agricultural extension support, rural livelihood diversification, and increased access to climate-resilient farming technologies.

4.6 Integrated Discussion of Findings

The findings of this study demonstrate that meteorological drought remains a major environmental and socioeconomic challenge affecting maize production and household food security in Mulanje District. The analysis of rainfall trends between 2010 and 2020 revealed substantial rainfall variability characterised by recurrent moderate and severe drought conditions, particularly from 2016 onwards. The persistence of below-normal rainfall during these years confirms the increasing instability of climatic conditions within the district and highlights the growing vulnerability of rain-fed agricultural systems.

The results further presented that recurrent drought conditions significantly affected household food security. Most households reported consuming only two meals per day, while a considerable proportion experienced food shortages lasting between three and four months annually. Low dietary diversity was also prevalent among respondents, reflecting reduced access to nutritious food during drought periods. These outcomes indicate that drought impacts extend beyond agricultural production and contribute to

nutritional vulnerability and declining household wellbeing. Reduced food consumption negatively affects labour productivity, health outcomes, and educational attainment. This is particularly among vulnerable groups such as children and elderly household members.

The coping strategies identified in the study further illustrate the vulnerability of households to climate-related shocks. The dominance of casual labour, meal reduction, and borrowing food indicates that most households rely on reactive and short-term survival mechanisms rather than sustainable adaptation measures. Although strategies such as crop diversification and adoption of drought-resistant crops were identified, their adoption remained relatively limited. This suggests that many households face structural barriers including poverty, inadequate extension support, limited irrigation infrastructure, and restricted access to agricultural inputs.

Overall, the study demonstrates that meteorological drought in Mulanje District is not merely a climatic issue but also a social and developmental challenge. The interaction between rainfall variability, declining maize yields, household food insecurity, and limited adaptive capacity highlights the need for integrated policy responses that address both environmental and socioeconomic dimensions of vulnerability.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The research investigated the impact of meteorological drought on maize availability and household food security in Mulanje District between 2010 and 2020. The findings demonstrated that rainfall variability and recurrent drought conditions significantly affected agricultural productivity and household livelihoods within the district.

The first objective sought to examine the frequency and severity of meteorological drought in Mulanje District. The analysis of rainfall trends revealed considerable climatic variability over the study period, with recurrent moderate and severe drought conditions becoming increasingly common, particularly from 2016 onwards. The findings indicate that rainfall patterns in the district have become increasingly unreliable, thereby affecting the stability of rain-fed agricultural production systems. The second objective examined the relationship between meteorological drought and maize production. The findings established a strong positive relationship between rainfall levels and maize yields, confirming that reductions in rainfall were associated with declining maize productivity. The statistical analysis revealed that maize production in Mulanje District is highly sensitive to climatic variability because most farming activities depend heavily on seasonal rainfall.

The third objective focused on the effects of drought on household food security. The study revealed that recurrent drought conditions contributed to reduced meal frequency, prolonged food shortages, and low dietary diversity among households. This data reveals that meteorological drought affects not only agricultural production but also household nutrition, wellbeing, and socioeconomic stability.

The fourth objective assessed the coping strategies adopted by households during drought periods. The outcomes showed that households mainly relied on short-term and reactive coping mechanisms such as casual labour, reducing meals, borrowing food, and dependence on government or NGO assistance. Although some households adopted adaptive strategies such as crop diversification and irrigation farming, the overall adoption of sustainable adaptation measures remained limited. This points that financial constraints, inadequate agricultural support services, limited access to irrigation

infrastructure, and low access to climate-resilient agricultural technologies continue to undermine household resilience.

Overall, the study concludes that meteorological drought remains a major threat to maize production and household food security in Mulanje District. The interaction between climatic variability, agricultural dependence, poverty, and limited adaptive capacity increases household vulnerability and undermines sustainable rural livelihoods. The findings therefore emphasise the importance of integrated climate adaptation strategies that address both environmental and socioeconomic dimensions of drought vulnerability.

5.2 Recommendations

Based on the results of the study, the following recommendations are proposed:

5.2.1 Strengthening Irrigation Development

The government and development partners should invest in small-scale and community-based irrigation schemes to reduce dependence on rain-fed agriculture. Expanding irrigation infrastructure would improve agricultural productivity during periods of below-normal rainfall and enhance household resilience to recurrent drought conditions.

5.2.2 Promotion of Drought-Resistant Crop Varieties

Agricultural extension services should promote the adoption of drought-resistant maize varieties and other climate-resilient crops. Improved access to certified seeds and farmer training programmes would help households reduce crop losses associated with drought and improve food security outcomes.

5.2.3 Enhancing Agricultural Extension Services

There is need to strengthen agricultural extension systems within the district through increased staffing, training, and farmer outreach programmes. Extension officers should provide farmers with climate information, drought preparedness training, and guidance on sustainable agricultural practices such as conservation agriculture and water management techniques.

5.2.4 Diversification of Rural Livelihoods

Households should be encouraged to diversify livelihood activities beyond rain-fed agriculture in order to reduce vulnerability to climate-related shocks. Support for small businesses, livestock production, agro-processing, and vocational skills development could improve household income stability during drought periods.

5.2.5 Improvement of Climate Information Systems

The Department of Climate Change and Meteorological Services should improve dissemination of seasonal weather forecasts and early warning systems at community level. Access to timely climate information would assist farmers in making informed decisions regarding planting periods, crop selection, and drought preparedness strategies.

5.2.6 Strengthening Social Protection Programmes

Government and non-governmental organisations should strengthen social protection programmes. These should target vulnerable households during drought periods. Food assistance, cash transfer programmes, and input subsidy initiatives could also help reduce the severity of household food insecurity during climate shocks.

5.2.7 Promotion of Sustainable Adaptation Strategies

Policy interventions should prioritise long-term and sustainable adaptation approaches rather than short-term coping mechanisms. Greater emphasis should be placed on climate-smart agriculture, environmental conservation, water harvesting, and community-based resilience programmes aimed at improving adaptive capacity within rural communities.

5.3 Areas for Further Research

This study focused primarily on meteorological drought and its effects on maize production and household food security in Mulanje District. Further studies should examine the long-term socioeconomic impacts of climate variability on rural livelihoods and poverty reduction. Additional research could also explore the effectiveness of specific climate adaptation programmes and the role of indigenous knowledge systems in drought management and resilience-building.

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APPENDICES

FINAL DATA COLLECTION TOOL

1. Household Survey Questionnaire

Section A: Demographic Information

1. Gender of household head

   ☐ Male ☐ Female
2. Age of household head

   ☐ 18–30 ☐ 31–45 ☐ 46–60 ☐ Above 60
3. Education level

   ☐ No formal education ☐ Primary ☐ Secondary ☐ Tertiary
4. Household size: _____
5. Main occupation

   ☐ Farming ☐ Business ☐ Casual labour ☐ Employment ☐ Other _____
6. Total land owned (ha): _____

Section B: Maize Production

1. Do you grow maize?

   ☐ Yes ☐ No
2. How many bags did you harvest last season? _____
3. Compared to 10 years ago, maize production has:

   ☐ Increased ☐ Decreased ☐ Remained the same
4. What factors affect maize production? (Tick all)

   ☐ Drought ☐ Pests/diseases ☐ Fertiliser shortage ☐ Poor soils ☐ Flooding ☐ Others ___

Section C: Meteorological Drought Experience (2010–2020)

(Aligned with Objective 1)

1. Have you experienced drought between 2010–2020?

   ☐ Yes ☐ No
2. How many drought events have you experienced (2010–2020)?

   ☐ 1–2 ☐ 3–5 ☐ More than 5
3. Which years had severe drought?
4. How severe were the droughts?

   ☐ Mild ☐ Moderate ☐ Severe
5. Typical duration of drought:

   ☐ <1 month ☐ 1–2 months ☐ >2 months
6. How often do droughts occur?

   ☐ Every year ☐ Every 2–3 years ☐ Rare

Section D: Impact of Drought on Maize Production

(Aligned with Objective 2 & 3)

1. Have you experienced maize crop failure due to drought?

   ☐ Yes ☐ No
2. If yes, how many times (2010–2020)?

   ☐ 1–2 ☐ 3–4 ☐ >5
3. Estimated maize yield loss during drought years:

   ☐ <25% ☐ 25–50% ☐ 50–75% ☐ >75%
4. Do you think drought is the main cause of low maize yield?

   ☐ Yes ☐ No

Section E: Household Food Security

(Aligned with Objective 3)

1. Do you harvest enough maize to last the whole year?

   ☐ Yes ☐ No
2. If no, how long does it last?

   ☐ 1–3 months ☐ 4–6 ☐ 7–9 ☐ 10–12

3. How many meals per day during food shortage?

   ☐ 1 ☐ 2 ☐ 3

4. Did your household experience food shortage in the past 12 months?

   ☐ Yes ☐ No

5. If yes, during which months? _____

6. What foods do you rely on during shortages?

   ☐ Maize ☐ Cassava ☐ Sweet potatoes ☐ Food aid

7. Do you think drought contributes to household food shortages?

   ☐ Yes ☐ No

Section F: Coping Strategies and Adaptation

(Aligned with Objective 4)

1. What strategies do you use during drought? (Tick all)

   ☐ Selling livestock

   ☐ Casual labour

   ☐ Borrowing food

   ☐ Reducing meals

   ☐ Crop diversification

   ☐ Irrigation

   ☐ Migration

   ☐ NGO/Government support

   ☐ Others _____

2. Which strategy do you rely on most? _____

3. When do you apply these strategies?

   ☐ Before drought ☐ During drought ☐ After drought

4. How effective are these strategies?

   ☐ Not effective ☐ Moderately effective ☐ Very effective

5. Have you adopted drought-resistant maize varieties?

   ☐ Yes ☐ No

6. Do you receive agricultural extension support?

   ☐ Yes ☐ No

2. Key Informant Interview Guide

Section A: Drought Trends

- What changes in rainfall patterns have been observed (2010–2020)?
- How frequent are drought events?
- Which years experienced severe drought?

Section B: Impact on Agriculture

- How has drought affected maize production trends?
- Which areas are most vulnerable?
- What is the relationship between rainfall variability and yield?

Section C: Food Security

- How does drought affect household food security?
- What are the main food insecurity challenges?

Section D: Coping and Adaptation

- What coping strategies are commonly used?
- How effective are these strategies?
- What role do extension services play?

Section E: Policy and Support

- What drought mitigation programmes exist?
- What improvements are needed to strengthen resilience?