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Water scarcity and small-scale maize farming at the rural household level: A case study of Matatiele Local Municipality, Eastern Cape, South Africa

By

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A mini dissertation submitted in partial fulfilment of the requirements for the degree

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Department of Geography and Environmental Science

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Declarations

I, Kholekile JIKWANA (201601876), hereby declare that I am fully aware of the University of Fort Hare's policy on plagiarism, and I have taken every precaution to comply with the regulations.

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I, Kholekile JIKWANA (201601876), hereby declare that I am fully aware of the University of Fort Hare's policy on research ethics, and I have taken every precaution to comply with the regulations. The Ethical clearance certificate number is: MAZ011SJIK01.

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I, Kholekile JIKWANA (201601876), declare that this is my own work and has not been submitted for a degree at any other university.

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Dedication

I dedicate this dissertation to my late Mother Mrs. Nolitha Lulama Jikwana, and my father Makabongwe Jikwana.

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Abstract

The impact of water scarcity on maize production and other agricultural products at the rural household level can affect food security as many small-scale farmers depend mostly on their farm produce for sustenance. Unpredictable changes in rainfall are known to impact the water supply for irrigation purposes. Moreover, Matatiele, the area under investigation is prone to periods of droughts and floods. The researcher investigated the effects of water scarcity on small-scale maize farming at the rural household level in the Matatiele area. The research objectives were to: 1) Describe and discuss the average monthly rainfall in the Matatiele area between 1993 and 2022. 2) To determine the rural household's food security status. 3) To determine the effect of water scarcity on rural small-scale crop farming and 4) to identify coping mechanisms on how to deal with water scarcity and food insecurity. A quantitative descriptive survey was employed to elicit information from participants. The rainfall pattern information was obtained from South African Weather Services, interpreted and described. A non-probable sampling technique was used to interview 140 household heads, using a structured questionnaire. The results demonstrated that the rainfall patterns in the Matatiele area vary from year-to-year. The lowest rainfall precipitation between 1993 and 2022 was 470.7 mm in 2015, and the highest was 1135 millimetres in 2022. The small-scale farmers experience moderate food security, as 67.9% of the participants stated that they never had to skip a meal, 70% never had to ration the size of meals, and 77.1% never went without food for a whole day. Most (82.9%) of the participants in this study reported that water access and water scarcity are their most considerable constraints when it comes to farming maize and other agricultural produce. They do not have access to municipal water, so most use private water sources such as boreholes. Only 18.6% use communal water sources, and only 5.7% use government-provided water sources. The variability impacts small-scale farmers, as they need long-term coping strategies to cope with the year-on-year variability yearly in rainfall patterns. They rely on short-term strategies such as borrowing food from neighbours during hard times. Water scarcity is a reality and impacts small-scale farming at the rural household level negatively, which leads to food insecurity. A needs assessment is recommended to determine how the local government can assist small-scale farmers in dealing with the erratic rainfall pattern, which displays periods of droughts and floods. Long-term

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strategies are recommended, such as implementing water tanks and building dams and irrigation systems, to support small-scale farmers during periods of food insecurity.

Keywords

Small-scale farming, maize farming, water scarcity, South Africa.

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Acronyms

NGO	Non-Governmental Organisations
SDG	Sustainable Development Goals
SSA	Sub Saharan Africa
SSPS	Statistical Package for Social Sciences
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Orientation to the study

Chapter One-Orientation to the study

1.1 Introduction

United Nations Educational, Scientific and Cultural Organization (UNESCO) Director-General Audrey Azoulay stated at the United Nations (UN) 2023 Water Conference that "Water is a common future…" and mechanisms should urgently be put in place "to prevent the global water crisis from spiralling out of control. It is projected that between 1.7 and 2.4 billion people in the global urban population will face water scarcity by 2050 (Fazel, 2023:2). The rising prevalence of severe and protracted droughts is concurrently exerting pressure on ecosystems, resulting in grave ramifications for plant and animal species (Fazel, 2023). The rising water scarcity reduces availability while at the same time increasing demand from agricultural and industrial growth, which consumes about 70% of the global water supply (Fazel, 2023). Experts believe that water should be managed as a "common good, not a commodity," because the commodification of water will derail the efforts achieved by the implementation of the Sustainable Development Goals (SDGs), and [rural] communities should be at the centre of attention when discussing water scarcity (Fazel, 2023).

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Due to its annual precipitation levels, which are 40% below the global average, South Africa is known as a country that struggles with water scarcity (Igamba, 2022). As a result, it is among the group of thirty countries with the least amount of precipitation in the world (Igamba, 2022). Water scarcity is a prevalent issue in the country, with a highly uneven distribution that disproportionately impacts rural areas (Igamba, 2022). Small-scale agricultural crop producers are particularly susceptible to the effects of climate change on precipitation patterns, notably the amplified rainfall variability. Consequently, this gives rise to a scenario in which the food security of billions of individuals is jeopardised. The presence of water significantly influences the process of food production. The issues above have been further intensified because of climate change. Climate change is projected to lead to heightened intensity and frequency of meteorological phenomena such as drought while diminishing their predictability over time. This phenomenon is anticipated

to result in a reduced predictability of water availability for agricultural and food production purposes throughout various regions of South Africa. The coping mechanisms and techniques already in place by small-scale farmers in rural areas may need to be revised to address significant rainfall timing and magnitude alterations.

In 2021–2022, South Africa was the top producer of maize in Africa and the ninth-largest producer globally (Maize Farming, 2023:1). Maize in South Africa is also known as mealies or corn, and a total of fourteen million metric tonnes of maize are produced in South Africa each year, of which twelve million metric tonnes are white maize, and two million metric tonnes are yellow (Maize Farming, 2023). Maize is an important food crop in South Africa, and it is farmed all around the country (Ala-Kokko et al., 2021). Maize is commonly used as a staple food and animal feed in South Africa (Ala-Kokko et al., 2021). Maize production has expanded dramatically in recent years due to improved farming practices, but climate change has impacted the farming of maize, especially in rural areas (Maize Farming, 2023).

The impact of water scarcity on maize production and other agricultural products at the rural household level is crucial for ensuring food security (Nephawe et al., 2021). Maize is the primary food source for many rural households, and a reduction in maize yields can lead to food insecurity (Dunjana et al., 2022). In addition, reducing maize yields or any other agricultural product can negatively impact rural households' income, as many households rely on small-scale agricultural product sales to generate income (Dunjana et al., 2022).

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This study examined the impact of water scarcity on maize and other agricultural farming activities at the rural household level in the Matatiele Local Municipality. Chapter One gives a general overview of the problem's background and states the study's problem, aim, and objectives. It refers briefly to the research methodology and elaborates on the ethical principles adhered to during the execution of the study.

1.2 Background to the problem and problem statement

At the 2022 United Nations Climate Change Conference, or COP27, held in in Egypt (Keulertz, 2023), the UN secretary-general, António Guterres stated that the world was "on a highway to climate hell with our foot on the accelerator" (El-Sheikh, 2022). During the COP27 summit, water scarcity was firmly placed on the agenda, as several sessions focused on the global water scarcity (El-Sheikh, 2022). Global water scarcity is a major

obstacle to human progress and the attainment of the SDGs (Dolan et al., 2021). As a result of the overexploitation of freshwater resources in many regions of the world, water shortages are spreading rapidly across the planet. This is due to population expansion, changes in water consumption habits, and anticipated climate change impacts, which consume the maximum global capacity for freshwater availability (Ingrao et al., 2023).

Water scarcity refers to a situation in which freshwater demand exceeds the availability (Rosa et al., 2020:1). Water scarcity has two dimensions: physical and economic (Intergovernmental Panel on Climate Change [IPCC], 2022). Physical scarcity occurs when there is inadequate water to supply the demand. Indications of physical shortage include significant environmental degradation, declining groundwater levels, and unequal water distribution (IPCC, 2022). Economic water scarcity arises from insufficient investment and inadequate management to fulfil the needs of persons who need more financial capacity to access available water sources. Common indications of economic water scarcity include inferior infrastructure (IPCC, 2022). Economic water scarcity is most prevalent in rural areas and affects the most vulnerable people (Sabbil & Abdulrahman, 2022).

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Around 70% of the water used globally is used for agriculture, contributing to water pollution by using too many nutrients, pesticides, and other contaminants (Ingrao et al., 2023). Changes in the seasonal timing of rainfall impact water supply and agriculture and increase the frequency and severity of floods and droughts (Nhemachene et al., 2020). Sabbil and Abdulrahman (2022) assert that water scarcity has several negative implications for rural household economies, such as health and sanitation, food security, time, income, and resource allocation. The primary cause of water scarcity in Sub-Saharan Africa (SSA) is economic water scarcity, resulting from a discrepancy between the demand for water and its availability in terms of time and location (Mekonnen et al., 2016). To increase household-level agricultural production, sustainable management of water in agriculture is essential; therefore, communities must ensure that water is shared with other users and that water systems' environmental and social advantages are maintained (Bazaanah & Mothapo, 2023).

Nephawe et al. (2021) confirm that water scarcity is a problem in South Africa due to the low rainfall and insufficient storage solutions; moreover, South Africa is exposed to droughts and high temperatures throughout all four seasons (Nephawe et al., 2021). The existing rainfall levels need to be increased to meet the needs of all sectors that require

water, and in addition, the country suffers from significant evaporation rates (Mahlalela et al., 2020).

Agriculture is an important economic sector in countries dealing with poor water resource utilisation and delivery (Li et al., 2020). Climate change has unprecedentedly impacted agricultural farming and food production (Zhang et al., 2022). Climate change puts strain on agricultural farmers, which can result in hunger or malnutrition at the household level (Zhang et al., 2022). One of the most significant grains in the world, maize, requires nearly a twofold increase in production to keep up with expanding food, biofuel, and livestock feed demand, especially in developing nations (Erenstein et al., 2022). Furthermore, maize is a primary food staple for over 4.5 billion individuals residing in ninety-four developing nations (Simanjuntak et al., 2023). As the top producer of maize on the African continent, South Africa uses maize as a staple food, and commercial growers produce large-scale maize to support its economy. On the other hand, smallholder farmers primarily depend on maize and vegetable production to maintain their socioeconomic livelihood and well-being (Simanjuntak et al., 2023).

Dinar et al. (2019) state that commercial farmers increase productivity by developing and implementing technologies that modify crops to grow well using less water and a lower quality of soil, but these technologies are not available at the household level. In South Africa, small-scale farmers in rural areas are more likely to be affected by water scarcity because they lack the means, such as technologies and finances, to deal with the threat of irrigating maize lands (Mwale et al., 2021).

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Agbugba et al. (2020) assert that maize is the predominant crop that smallholder farmers farm within the summer months in areas of the Eastern Cape (EC) Province. The average yield is less than one tonne per hectare, mainly due to low and erratic rainfall patterns. The authors further comment that the soil in the EC is shallow, easily crusted, and naturally infertile (Agbugba et al., 2020). Matatiele is a small village in the EC, and many households depend on small-scale maize and vegetable farming (Matatiele IDP Review, 2017). To ensure livelihoods, it is important to implement coping strategies to enhance crop yield while reducing non-beneficial water losses to sustain water management (Matatiele IDP Review, 2017). Water scarcity is a significant issue impacting numerous provinces and communities in South Africa. Amoah and Jali (2022) assert that there needs to be more empirical research examining the ramifications of water scarcity on small-scale farmers and the corresponding coping mechanisms they choose.

The problem is that Matatiele is a rural village in the Eastern Cape where the community relies largely on small-scale maize and vegetable farming to stay alive. Omarjee (2023) reported that South Africa has experienced its fourth hottest year on record in 2022, since 1951. The Matatiele Local Municipality, in the Eastern Cape Province of South Africa, similarly experienced above average temperatures linked to widespread and erratic changes in weather patterns. South Africa faces a developing water crisis because of dwindling water supplies and extensive water quality problems (Nyam et al., 2020). Water availability for farming is a prerequisite for generating excellent and profitable unit yields and quality yields. Water scarcity reduces agricultural output and lowers the value of agricultural output, affecting GDP and economic development (Alrwis et al., 2021).

Climate change causes increased floods and droughts, negatively impacting agricultural farming. Small-scale farmers must receive accurate information on how to properly use scarce or changing rainfall to boost crop output and ensure food security in the future (Kephe et al., 2022). However, empirical studies have yet to be conducted to evaluate the effects of water scarcity on small-scale maize and vegetable farmers and the coping strategies they employ in Matatiele Local Municipality. This study examined the impact of water scarcity on small-scale maize and vegetable production at the rural household level in the Matatiele Local Municipality to determine coping strategies that could be employed to assist the small-scale maize farmers.

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1.3 Aim of the study

This study aimed to determine the effect of water scarcity on maize and other agricultural crop farming at the rural household level in Matatiele Local Municipality.

1.4 Objectives

The objectives of the study were to:

- Describe and discuss the average monthly rainfall in the Matatiele area between 1993 and 2022.
- Determine the rural household’s food security status.
- Determine the effect of water scarcity on rural small-scale crop farming.
- Identify coping mechanisms to deal with water scarcity and food insecurity.

1.5 Research questions

- How did the monthly average rainfall in the Matatiele area change between 1993 and 2022?
- What is the rural household food security status in the Matatiele area?
- What is the effect of water scarcity on rural small-scale crop farming?
- How do small-scale farmers cope with water scarcity and food insecurity?

1.6 Rationale and Significance of the study

The rationale or justification of this study is related to the fact that there is a gap in the literature related to information on water scarcity and its impact on small-scale agricultural crop farming at the rural household level in South Africa.

The significance of the study is that the findings gained contributed to the academic knowledge, as a manuscript will be sent to an accredited peer-reviewed journal for publication. The results also emphasise the difficulties of rural small-scale farmers in the Matatiele Local Municipality. It is hoped that the municipality will address the farmers' needs when the results are presented to the policymakers. The information gathered will be used to inform and guide local policies to enable the municipality to address the challenges of the small-scale farmers related to how water scarcity impacts maize and vegetable production. The research may stimulate small-scale farmers thoughts on how to deal with a possible increase in water scarcity in the future. The results will be shared with the participants during feedback sessions in the area, after publication of the dissertation, which may give them some ideas of how to cope with water scarcity. The publication of the results may promote further investigation into water scarcity, maize and vegetable production, and rural household levels in South Africa.

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1.7 Delimitations and limitations

The study was limited to rural households in the Matatiele Local Municipality. Time and sample size are a limitation because this is only a mini-dissertation and not a full dissertation.

1.8 Dissertation outline

Chapter One introduced the background of the problem and the problem statement. The aim of the study, research objectives, and research questions were stated. The significance and justification were stated. Chapter Two critically engaged with literature related to the study's objectives, and Chapter Three outlined the research methodology implemented to execute the project. The findings of the study are presented in Chapter Four, and Chapter Five concludes the research project with a discussion of the findings and recommendations for practice and further research.

1.9 Chapter One summary

Chapter one presented an introduction and background to the research project, which focused on the impact of water scarcity on small-scale maize and vegetable production at the rural household level and the rainfall pattern in the Matatiele area between 1993 and 2022. This study was necessitated due to the perceived water scarcity by the local small-scale farmers in the area, as a result of their experience of the unpredictable rainfall pattern. The study aimed to determine the effect of water scarcity on maize and other agricultural crop farming at the rural household level in Matatiele and concluded with the structure of the dissertation which is divided in five chapters. The following chapter critically evaluates empirical studies related to research objectives.

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Literature review

Chapter-Two-Literature review

2.1 Introduction

A literature review is a systematic endeavour to better understand the existing body of knowledge in a particular field by examining published or documented information. The process entails a methodical approach to identifying, locating, and analysing relevant texts that contain information about the research objectives (Sileyew, 2020). The main objectives of a literature search are to identify what has been written on the topic and what gaps in knowledge exist. An electronic literature search was performed to locate the relevant sources about water scarcity and small-scale farming at the rural household level. The investigation was conducted through electronic resources like EBSCO and ScienceDirect. The Google Scholar search engine was also employed. The search strategy involved using specific terms such as: 'coping strategies', 'food insecurity', 'household', 'rural', 'small-scale farmers' and 'water scarcity'. The scope of the literature was limited to the English language. The results of the literature are discussed below, and a gap related to the effect of water scarcity on maize and other agricultural crop farming at the rural household level in Matatiele Local Municipality has been identified.

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2.2 Effect of water scarcity on small-scale agricultural farmers

Water scarcity due to extended periods of drought and erratic precipitation poses significant difficulties in ensuring reliable and stable water provision for small-scale farmers (Abbass et al., 2022). Moreover, the excessive withdrawal of groundwater from aquifers, frequently for agricultural and industrial use, exacerbates the depletion of water tables (Yar, 2020). Water pollution in rivers as a result of intensive agricultural farming, industrial emissions, and inadequate wastewater treatment affects small-scale farmers who farm close to these rivers (Masindi et al., 2022). Moreover, the exponential increase in population and urbanisation exerts significant stress on water resources, given the escalating need for water to fulfil requirements related to drinking, sanitation, and industrial

activities (Igamba, 2022). Insufficient water management practices and suboptimal water utilisation exacerbate the demand for existing water resources, resulting in a worldwide water crisis that impacts a substantial portion of the global population. South Africa has a notable disparity in the distribution of precipitation, wherein certain areas see ample rainfall while others are classified as desert or semi-arid. The problem of unequal access to water resources is an additional concern, as historically marginalised populations frequently face challenges in obtaining consistent access to safe drinking water and adequate sanitation facilities (Abrams et al., 2021).

Section 27 (1) (b) and (2) of the Constitution of the Republic of South Africa (1996) states that “Everyone has the right to have access to… (b) Sufficient food and water; and…The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights”. The Minister of Water Affairs and Forestry made a public declaration regarding the government’s decision to provide impoverished homes with a complimentary water allocation, guaranteeing them access to a fundamental water supply (Algotsson & Murombo, 2009). The Cabinet approved a monthly programme to supply 6,000 litres of potable water to each household (Cothren, 2013).

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Small-scale farmers who engage in agricultural activities on land holdings smaller than two hectares have a vital role in global agricultural production, accounting for around 80% of the world’s yearly crop harvest (Aguilar et al., 2022). Water scarcity is anticipated to occur increasingly, posing a significant risk to small-scale farmers, who are particularly susceptible to its impacts. These small-scale farmers are more susceptible to water scarcity, market fluctuations, and weather variations than farmers with more significant amounts of farmland and more excellent financial resources (Aguilar et al., 2022). Moreover, water scarcity significantly impacts both the quality and quantity of agricultural harvests, directly influencing food security, the probability of social conflicts, and the broader issue of rural poverty (Aguilar et al., 2022).

The issue of water shortage presents a significant and urgent problem for small-scale agricultural farmers in South Africa, resulting in wide-ranging implications that impact their means of subsistence and the surrounding populations (Meza et al., 2021). Small-scale farmers who have limited low resources and who lack access to modern agricultural techniques, are the most affected by unpredictable precipitation patterns and water scarcity (Igamba, 2022). The decrease in water availability directly correlates with a decline in agricultural yields, posing a significant threat to the food security of farmers and

neighbouring communities (Masipa, 2017). This phenomenon exerts significant pressure on rural economies and exacerbates the perpetuation of poverty and inequality.

Furthermore, the issue of water shortage further compounds the already formidable challenges confronted by small-scale farmers in South Africa, particularly concerning their limited access to irrigation systems and contemporary agricultural techniques (Mwale et al., 2021). Many small-scale farmers face financial constraints that hinder their ability to invest in water-efficient technologies, rendering them vulnerable to the impacts of precipitation variability. Moreover, the escalation of rivalry for scarce water resources frequently engenders conflicts among agricultural practitioners across various societal sectors, encompassing urban regions and industrial enterprises (Alotaibi et al., 2023). The above phenomenon diminishes social bonding and impedes collective endeavours to mitigate water scarcity (Alotaibi et al., 2023).

About 95% of small-scale agricultural practices depend on rainfall as the primary source of water systems (Hlophe-Ginindza & Mpandeli, 2021). According to a study by Amoah and Jali (2022), small-scale farmers in the Libode district of the Eastern Cape encounter challenges, including delays in crop growth and crop loss resulting from water constraints. As a result, there is a decline in enthusiasm for small-scale agricultural production and an increase in concern about potential health risks. There is a complex interrelationship between health and crop growth. Delayed crop growth and crop loss can lead to an increase in plant pathogens and can cause outbreaks of aflatoxicosis (Rizzo et al., 2021). Moreover, delayed crop growth or loss reduces food availability, compromising immune systems and leading to malnutrition (Rizzo et al., 2021).

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In conclusion, the impact of water scarcity on small-scale agricultural farmers in South Africa extends beyond environmental implications, encompassing a range of complex issues that jeopardise food security, economic stability, and health. Consequently, it is imperative to address this multifaceted challenge promptly and implement sustainable measures to enhance the resilience and survival of these farmers amidst a progressively uncertain future.

2.3 Effect of climate change on water scarcity

Climate change is considered one of the primary natural contributors to water scarcity, as it results in alterations in precipitation patterns and heightened rates of evaporation (Abbass et al., 2022). The climate change phenomenon presents an escalating and severe

threat to the availability and quality of water resources worldwide, leading to persistent difficulties related to water shortages worldwide (Chu & Karr, 2017). The increase in temperatures has expedited the glacial and polar ice cap melting processes, leading to disturbances in the fragile equilibrium of freshwater accessibility (Thorsteinsson et al., 2013). The depletion of these essential freshwater resources has deteriorated the availability of clean drinking water and the ability to engage in agricultural irrigation in various places (Tzanakakis et al., 2020). In addition, modified precipitation patterns resulted in increased occurrences of prolonged and severe droughts in specific regions and heightened instances of heavy rainfall and subsequent flooding in other locations (Ebi et al., 2022). The unpredictable nature of weather patterns introduces complexities in managing water resources and planning infrastructure and challenges communities to adapt to these swift transformations (Jovanovic et al., 2020).

Climate change has not only modified the distribution and accessibility of water but has also increased the competition for this limited resource (Chu & Karr, 2017). The escalation of global temperatures leads to a heightened need for water in many sectors, such as agriculture, industry, and households, exacerbating pre-existing disputes and tensions surrounding water entitlements (Chu & Karr, 2017). Resolving the interconnected issues of climate change and water shortage necessitates international collaboration and the development of inventive strategies that prioritise sustainable water management, conservation initiatives, and the mitigation of greenhouse gas emissions (Fawzy et al., 2020). In the absence of prompt intervention, the escalating water crisis poses a significant threat not just to the welfare of societies but also to the equilibrium of ecosystems and economies on a global scale.

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The 2015 SDGs have prioritised community development, the enhancement of small-scale farmers' livelihoods, and climate resilience (United Nations, 2023). SDG 2.3 endeavours to achieve the objective of augmenting agricultural production and the incomes of small-scale food producers twofold within the timeframe of 2030 (United Nations, 2023). To effectively accomplish the objective of SDG 2.3, it is essential to ensure the long-term viability of small-scale farmers' production and incomes in the face of climate shocks and stressors.

As climate change persists, alterations in precipitation patterns will engender more marginalisation of small-scale farmers who lack adequate access to water and technologies, impacting their livelihoods (Ricciardi et al., 2020). Dynamic interventions are required to address the problems presented by climate change and to achieve food security at household levels (Hlophe-Ginindza & Mpandeli, 2021). More than 80% of the

global agricultural sector comprises small-scale farmers, contributing significantly to the overall food chain (Ricciardi et al., 2020). Farms with an area of less than 5 hectares are responsible for almost 50% of the total global food production (Ricciardi et al., 2020).

By 2050, 87 of 180 countries will be classified as water scarce, and SSA will become the hotspot of water scarcity (Baggio et al., 2021). Water availability in South Africa varies greatly, and South Africa has less water per capita than people in Namibia and Botswana (Wilkinson, 2017). In 2017, every person in the country had 822.2 cubic metres of freshwater available, less than half of the standard fifty litres per person per day set by the World Health Organisation, making South Africa the 30th driest country in the world (Wilkinson, 2017).

2.4 Rural household food security status

Ouda and Zohry (2020) assert that a correlation exists between water shortages and food production. Efficient use of water resources for agricultural purposes is necessary to enhance food production while maintaining the same level of water consumption (Ouda & Zohry, 2020). The situation of rural households in South Africa continues to be complex and urgent, with several challenges impacting the welfare of numerous people living in isolated and socioeconomically underprivileged areas (Mthethwa & Wale, 2021). Despite the considerable agricultural potential inside the nation, many rural households persistently encounter food insecurity due to a confluence of variables (Crush et al., 2011). One of the foremost issues lies in the inequitable allocation of land and resources, a predicament that can be traced back to the historical period of apartheid in South Africa (Movik, 2009). The pace of land reform initiatives needs to be more active and frequently marked by controversy, resulting in many rural people needing more opportunities to utilise arable land and essential farming resources (van Rensburg & Walsh, 2023). The absence of available arable land significantly contributes to the susceptibility of rural households, rendering them reliant on external sources of income and food aid (van Rensburg & Walsh, 2023).

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In addition, climate change and its corresponding consequences, such as extended periods of drought and unpredictable rainfall patterns, have intensified food insecurity in rural regions (Amoah & Simatele, 2021). The climate-related issues faced by rural populations in South Africa, which significantly depend on rain-fed agriculture, render them particularly susceptible (Ngcamu & Chari, 2020). This vulnerability is mainly attributed to their limited access to adequate infrastructure and resources, hindering their ability to

adapt to these challenges successfully. The limited availability of high-quality healthcare, education, and social services in numerous rural regions hampers households' ability to enhance food security (Ngcamu & Chari, 2020). The effective resolution of rural household food security in South Africa necessitates implementing a comprehensive strategy including various dimensions, such as equitable land distribution, adopting agricultural practices robust to climate change, and enhancing accessibility to vital services such as water (Ngcamu & Chari, 2020). Furthermore, implementing focused social safety nets and community-driven programmes plays a pivotal role in assisting rural households in breaking the cycle of food insecurity and establishing resilient means of living. Tadesse and Zeleke (2022) reported that a food assistance programmes, like the Productive Safety Net Programme (PSNP) implemented in Ethiopia improved the income and food security at the household level in food-insecure areas. Larkin (2024), reported that several community and non-governmental organisations (NGOs) play and important role in alleviating hunger in food insecure communities.

2.5 Small-scale maize and vegetable farming

The practice of small-scale maize and vegetable farming in rural South Africa holds significant importance, serving as both a means of sustenance and a strategy to tackle food security challenges while fostering sustainable agricultural methods (Hlophe-Ginindza & Mpandeli, 2021). Within the Eastern Cape rural landscapes, smallholder farmers frequently cultivate maize and a diverse range of vegetables on comparatively modest plots of land. Maize, a staple crop in South Africa, fulfils a crucial role as a primary sustenance provider for numerous households. Concurrently, cultivating vegetables enhances dietary variety and augments income streams for these families. Small-scale farmers commonly use traditional farming methods handed down from generation to generation and do not employ high technology when farming (Hlophe-Ginindza & Mpandeli, 2021). However, there is an increasing endeavour to include contemporary, sustainable farming approaches that have the potential to improve crop productivity and mitigate environmental consequences (Hlophe-Ginindza & Mpandeli, 2021).

Moreover, small-scale farmers in rural South Africa exhibit remarkable resilience and adaptation while encountering restricted resource availability, including high-quality seeds, irrigation facilities, and agricultural education (Bukhosini & Moyo, 2023). Various community-based initiatives, non-governmental organisations (NGOs), and government programmes have provided training, resources, and market access to assist farmers in

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their endeavours (Mokgomo et al., 2022). In addition, small-scale agriculture enhances local food production, cultivates communal togetherness, and empowers individuals to assume control over their economic welfare (Mokgomo et al., 2022).

In South Africa's ongoing challenges with food security and rural development, the cultivation of maize and vegetables on a small scale holds significant importance as a fundamental element in achieving sustainable agricultural practices and fostering rural prosperity.

2.6 Small-scale farmers' coping mechanisms in times of water scarcity

The recognition of appropriate coping techniques for the diverse and extensive population of farmers in addressing the growing problem of water scarcity has been a significant focus in endeavours to alleviate poverty and develop a resilient agricultural system (Ricciardi et al., 2020). The concept of resiliency to water scarcity encompasses the capacity of farmers to mitigate or adjust to the consequences of water scarcity while preserving the functionality, composition, and essence of their livelihoods (Aguilar et al., 2022). To stay abreast, small-scale farmers have implemented adaptive measures, including mulching by surrounding plants with grass and irrigating the land to conserve limited water resources. Others have resorted to procuring water from private suppliers and engaging in water reuse as coping techniques (Amoah & Jali, 2022).

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Ouda and Zohry (2020) argued that there is a need to improve irrigation practices because current irrigation methods fall short of adequately fulfilling crops' water needs, giving rise to adverse circumstances for plant development and ultimately leading to reduced yields and worsening concerns regarding food insecurity. Deficit irrigation is universally acknowledged as a practical water management approach, and achieving efficient utilisation of water resources in the agricultural sector is possible. According to the study by Stringer et al. (2021), implementing effective water management practices, advancements in technology and infrastructure, and improved demand and supply management strategies can contribute to more significant equity in accessing water resources. Considering the water shortage, farmers have devised diverse strategies to safeguard the viability and sustenance of their crops. Some small-scale farmers implemented coping mechanisms such as water harvesting, measures for soil improvement, and cultivating drought-resistant crops to survive during the dry months (Ricciardi et al., 2020). Other frequently employed approaches involve utilising crop types

that exhibit resistance to drought conditions and implementing irrigation techniques that optimise water usage (Nikolaou et al., 2020).

Furthermore, implementing rainwater harvesting systems and utilising small-scale reservoirs are employed to effectively store and manage water resources (Mogano & Okedi, 2023). These measures enable farmers to mitigate the challenges posed by periods of limited rainfall (Mogano & Okedi, 2023). These adjustments not only serve to maintain agricultural production but also play a role in safeguarding traditional farming knowledge and practises (Mogano & Okedi, 2023). In addition, it is common for small-scale farmers to participate in community-driven initiatives to exchange resources and information (Hlophe-Ginindza & Mpandeli, 2021). Collaborative endeavours, such as establishing collective irrigation initiatives, facilitating the consolidation of resources, exchanging knowledge regarding water management techniques, and joint advocacy for improved water resource accessibility, also assist in water conservation (Hlophe-Ginindza & Mpandeli, 2021). The implementation of communal solutions cultivates resilience and enhances social cohesion within agricultural communities as farmers collectively collaborate to tackle the shared issue of limited water resources (Hlophe-Ginindza & Mpandeli, 2021).

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The adaptable techniques used by small-scale farmers offer hope for promoting sustainable agriculture despite an unpredictable climate outlook, considering the significant challenge that water shortages pose in South Africa.

2.7 Chapter Two summary

In summary, the preceding sections have provided insight into the complex relationship between climate change, water shortage and their significant impacts on rural small-scale agricultural farmers. The interconnection among these variables is apparent in the difficulties these agricultural practitioners encounter as they strive to sustain their means of subsistence and guarantee the availability of nourishment amidst the decline of water supplies. The significance of managing water scarcity becomes evident when considering the susceptibility of small-scale agricultural farmers and their coping techniques. Moreover, analysing the fundamental factors contributing to water scarcity highlights the pressing need to adopt sustainable and adaptable approaches to alleviate its consequences. As we further explore the complexities of this matter, it becomes increasingly apparent that a comprehensive strategy is needed to protect the welfare of rural communities and promote their ability to adapt during persistent climate change and water scarcity.

Research methodology

Chapter Three-Research methodology

3.1 Introduction

Chapter Three focuses on the essential elements of the research methodology, thoroughly examining the approach, design, setting, population, sampling methodology, sample size determination, measuring instruments, data collection methods, data analysis techniques, and the critical evaluation of reliability and validity.

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3.2 Research setting and study area

The Matatiele Local Municipality, located in the Eastern Cape Province of South Africa, offers an intriguing and varied research environment due to its distinctive combination of cultural, geographical, and socio-economic characteristics. Matatiele is close to the Drakensberg Mountains and is characterised by a visually stunning natural environment encompassing a diverse range of topographical features, including verdant valleys, and challenging mountainous terrain. The land is predominantly farmland, previously dominated by wetlands. History states that Matatiele derives its name from the Sotho word *matata*, meaning wild ducks and *ile*, meaning gone. In the Phuti language, *mati* means water, and *ayile* means dried up. Thus, the wild ducks have flown away because the water has dried up (Matatiele Local Municipality, 2018).

Matatiele is a Category B municipality in South Africa's Eastern Cape Province's Alfred Nzo District (Matatiele Local Municipality, 2018). It borders Lesotho to the north, Elundini to the south-west, and Greater Kokstad to the east, and its 4,352 km2 area makes it the district's largest local municipality, accounting for over half of its geographical area in the northern part of the Eastern Cape Province of South Africa (Figure 3.1).

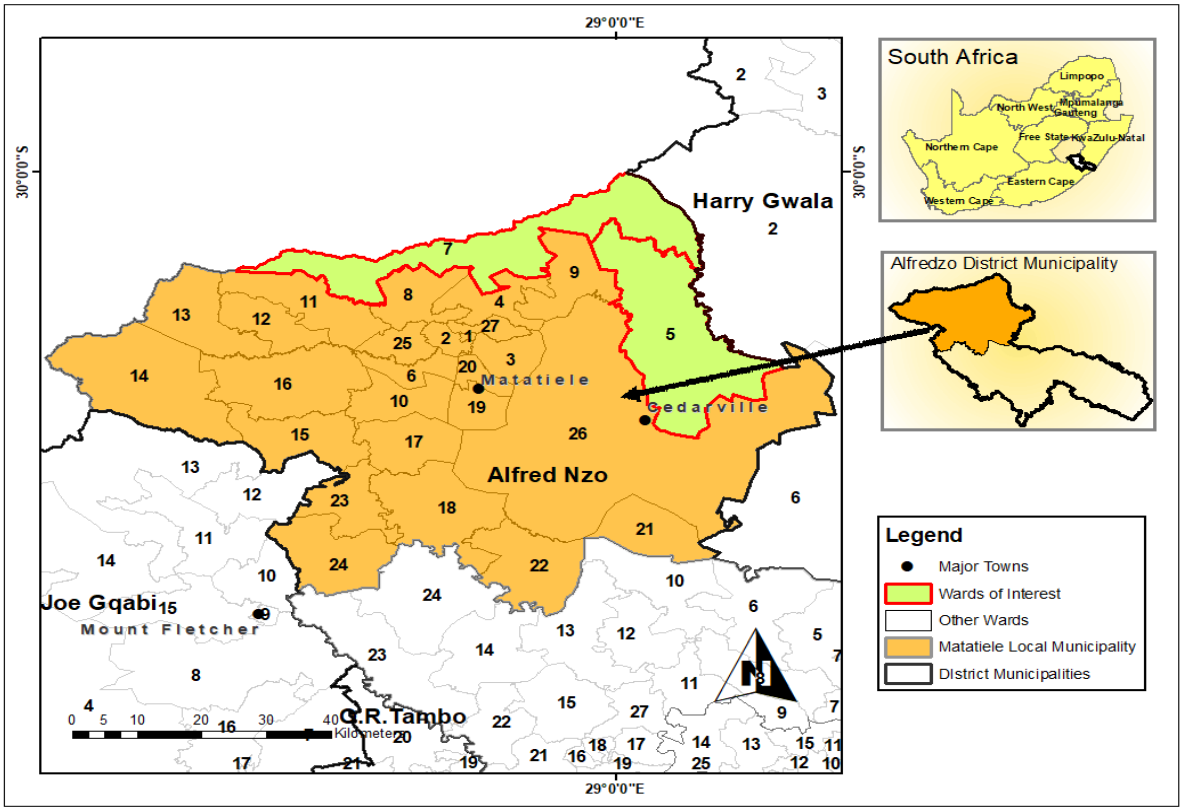


Figure 3.1 Map of Matatiele (Mkhanzi, 2023)

Source: Map Created by (Author & Velisile Mkhanzi with BSc (Hons.) in Applied Remote Sensing and GIS (University of Fort Hare).

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Matatiele is the most populous town in the Matatiele Local Municipality, with 12,466 people and 4,107 households, as reported by the South African National Census 2011 (Matatiele Local Municipality, 2018). Most (83.5%) of the inhabitants are Black Africans and use isiXhosa (48.3%) as their home language (Matatiele Local Municipality, 2018).

The Matatiele Local Municipality is in a semi-arid region of South Africa and a municipality struggling with water scarcity due to rivers, dams and boreholes drying up (Nzimakwa, 2017). The average annual rainfall is about 500 mm, which is highly variable (Mano & Nhemachena, 2017). In the Matatiele Local Municipality of the Eastern Cape Province, maize is the most essential crop rural households grow. However, water scarcity is a significant challenge facing maize production in this region. This can have a devastating impact on maize production, as maize is a water-intensive crop. The Matatiele Local Municipality uses much water for a variety of agricultural crop-producing objectives, and agriculture is the most significant human use of water, accounting for up to 80% to 90% of total human water usage across the Eastern Cape Province of South Africa (OECD Water,

2016). However, according to Wellington (2018), rising economic, demographic, and climatic pressures and rising global average temperatures have all contributed to recurrent concerns about water shortages, culminating in water scarcity in the Matatiele Local Municipality.

3.3 Conceptual framework

The capital framework as discussed by Aguilar et al. (2022) served as the framework that was used to determine how water scarcity affects rural households' small-scale crop farming, food security status and coping mechanisms in Matatiele. The conceptual framework was created considering factors that may contribute to water scarcity and how water scarcity affects maize and other agricultural crop farming at rural household levels. Aguilar et al. (2022) refer to the five capitals of sustainable livelihood (including food security), namely: Natural, Social, Physical, Financial and Human Capital.

Natural Capital includes concepts such as land ownership, nature of the soil, size of the land, access to water resources, irrigation systems and water storage. Social Capital includes concepts such as assistance from the government and participation in local small-scale farming associations. Physical Capital includes concepts such as available infrastructure, availability of seeds and fertilisers, possibility to sell excess crops (market and transport to market). Financial capital includes on- and off-farm income and livestock holdings which are often sold during tough times. Human capital refers to the level of education, age group, gender, and years of farming experience of the small-scale farmer. These capitals all influence how the small-scale farmer builds resilience to water scarcity and drive the coping mechanism that is used by the farmers to ensure a sustainable livelihood or to cope with food insecurity during insufficient crop production, which is mostly influenced by unpredictable rainfall patterns and climate change. (Figure 2.1)

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To demonstrate the interconnectedness of the capitals it is important to define the main concepts related to the conceptual framework. As stated under the background to the research problem, water scarcity is commonly understood as the state in which the water demand exceeds the available supply, resulting in an inability to adequately meet society's water needs (Thakur & Chakraborty, 2019). Water scarcity can be attributed to insufficient supply for all sectors and the absence of accessible, potable water, which is essential for meeting all human needs (Thakur & Chakraborty, 2019). Water scarcity can be classified into physical, economic, and institutional perspectives. Physical water scarcity refers to the insufficiency and poor quality of water resources, whereas economic scarcity pertains to

the inadequacy of water infrastructure resulting from financial and technical limitations. Institutional water shortage refers to the absence of an appropriate institutional framework or the lack of capacity to guarantee a reliable, secure, and fair provision of water (FAO, 2016).

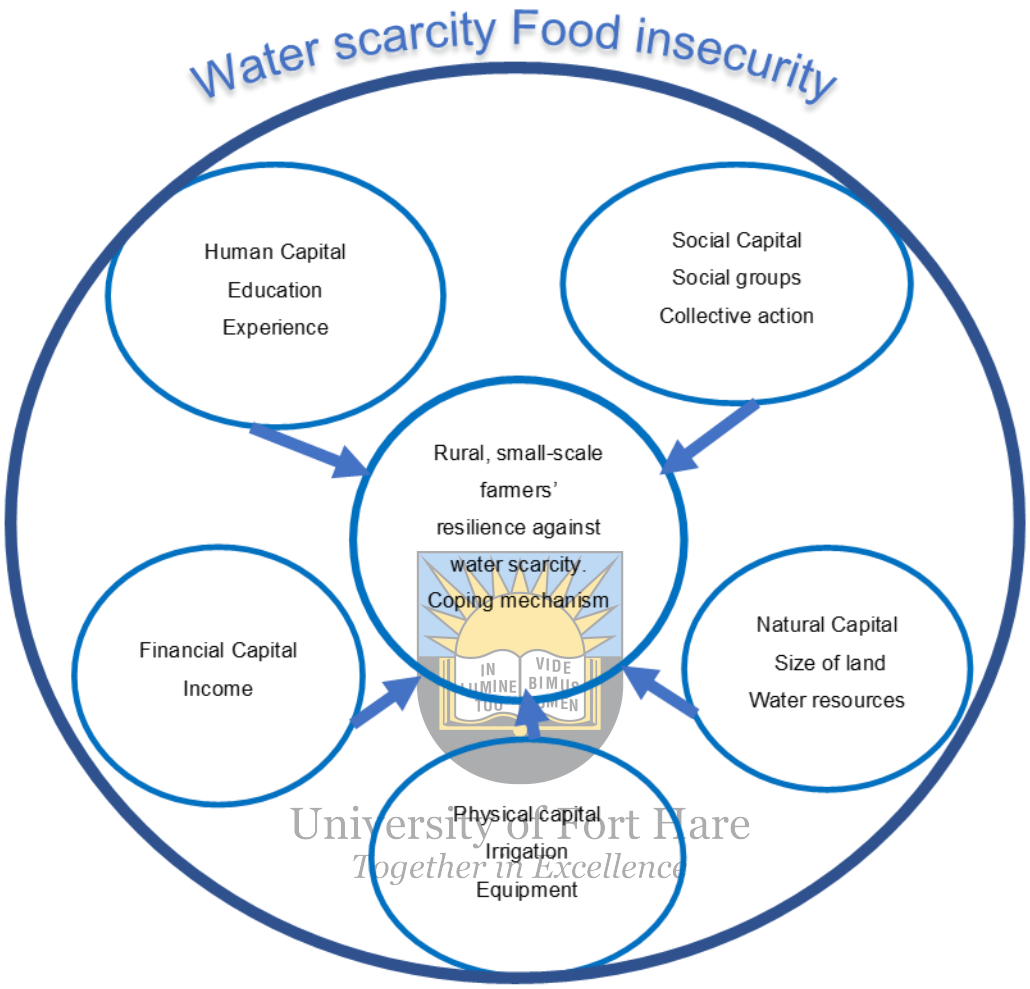
Moreover, water scarcity can be defined as regions where the per capita availability of water falls below 1700 cubic metres, which is lower than the World Health Organisation (WHO) minimum standard of fifty litres per person per day (Baggio et al., 2021). Individuals would face persistent water scarcity if the per capita water availability fell below one thousand cubic metres. Moreover, if it drops below five hundred cubic metres per capita, they will reside in extreme water scarcity, commonly referred to as "beyond the water barrier." (Baggio et al., 2021). Approximately 1.2 billion individuals globally reside in regions characterised by physical water scarcity. At the same time, an additional 1.6 billion people experience water scarcity due to inadequate infrastructure for water extraction from rivers and aquifers within their respective countries (Thakur & Chakraborty, 2019). One of the major challenges in rural areas are the availability of inadequate infrastructure for water extraction from rivers or aquifers and storage facilities for the extracted or rainfall water (Mothetha et al., 2013).

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The second concept that needs clarification is food security in relation to water scarcity. Ngcuka (2022:1) stated that the “Biggest threat to food security in SA is lack of subsistence farming “. Water scarcity has a significant impact on small-scale farmers food production. The absence of adequate water for irrigation poses a threat to water scarcity and food security in rural areas, as it hinders the production of sufficient food to meet the communities' needs (Nephawe et al., 2021). Moreover, small-scale farmers lack the ability to irrigate their crops, due to insufficient irrigation infrastructure resulting in a scarcity of food for their families (Nephawe et al., 2021). The scarcity of water for agricultural use is a significant global concern, with irrigation and storage of water being some of the main constraints (Nephawe et al., 2021). Small-scale farmers primarily cultivate a significant portion of their own food to safeguard against food insecurity, and this subsistence are negatively impacted when water is scares (Nephawe et al., 2021).

In the context of this study, food security refers to the state in which small-scale farmers and their families consistently have access to an adequate supply of safe and nutritious food that fulfils their dietary requirements and preferences, while also possessing the necessary physical and economic resources to obtain it (Tambe et al., 2023).

Small-scale farmers need to address the five capitals to enable them to build resilience and coping mechanisms against the unpredictable rain fall patterns, which often leads to water scarcity and directly cause food insecurity for small scale farmers in rural areas.



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Figure 3.2 Conceptual framework adapted from Aguilar et al., 2022.

3.4 Research approach

Creswell & Creswell (2018) categorise research into three primary approaches: qualitative, quantitative, and mixed-methods research. A mixed-methods research technique differs from a quantitative approach as it combines quantitative and qualitative data collection methods. In contrast, a qualitative approach narratively gathers information, focussing on the richness and depth of the data (Creswell & Creswell, 2018).

A quantitative research approach has been chosen to collect information based on information that can be counted and that is factual. Quantitative research methodologies are distinguished by their methodical and structured methodology for gathering and analysing numerical data to address research inquiries. The quantitative research approach can be described as the research plan and procedures that include the steps that will be followed during the execution of the project and involve the logical and detailed research methods of collecting, analysing, and interpreting information (Creswell & Creswell, 2018).

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The quantitative research approach depends on measurable variables and strives to reveal patterns, relationships, and statistical significance within the dataset. Quantitative research possesses a notable advantage in providing objective and replicable outcomes, rendering it highly suitable for investigations to establish causal connections or generalise findings to a broader population (Saunders et al., 2023). Academic researchers commonly utilise a range of data-collecting methodologies, including surveys, experiments, and observations, to acquire quantitative data that may be subjected to statistical analysis. Quantitative research is recognised for its inherent objectivity and capacity to yield exact measurements. However, it is essential to acknowledge that this approach may not comprehensively capture the intricate nuances of human experiences or emotions, as its primary emphasis lies in quantifiable data analysis.

The quantitative research approach is mostly associated with a positivist research philosophy as it examines information that can be numerically analysed and presented (Saunders et al., 2023). The criteria for selecting a quantitative approach for this study were based on the nature of the research problem that needed to be addressed through the research aim, namely, to investigate and describe the impact of water scarcity on maize farming at the rural household level in Matatiele Local Municipality (Creswell & Creswell, 2018). A specific quantitative research design was used that allowed information

to be quantified and analysed using statistical methods (Creswell & Creswell, 2018). This study used a quantitative research approach as explained above.

3.5 Research design

A descriptive, cross-sectional, survey design was used to gather information from the participants. Cross-sectional refers to the concept that it was done over a short time period across all the sites. Research design refers to the type of inquiry the researcher followed within the quantitative approach (Saunders et al., 2023). Several descriptive designs are available within a quantitative approach, such as experimental, quasi-experimental, factorial, correlation, and descriptive designs (Creswell & Creswell, 2018). The descriptive survey commonly employs quantitative research methodology that aims to systematically gather and synthesise data to depict and comprehend a population's attributes, actions, or perspectives or a particular subset within that group (Sileyew, 2020). Descriptive surveys are frequently utilised to address inquiries about current affairs such as the impact of water scarcity on small-scale farming at the rural household level in Matatiele. In the context of a descriptive survey, researchers employ the utilisation of questionnaires or structured interviews as a means to collect data from a sample that is representative of the target population (Sileyew, 2020). Surveys frequently utilise standardised scales, closed-ended questions, or rating scales to quantify replies, rendering the data suitable for statistical analysis (Sileyew, 2020).

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Quantitative descriptive surveys commonly employ descriptive statistics, such as percentages, means, and frequencies, to describe the findings. These statistical measures enable researchers to offer succinct and lucid descriptions of the discerned patterns and trends in the data. Although lacking in the exploration of causal linkages or explanations, descriptive surveys play a pivotal role in establishing a solid groundwork for further research endeavours and decision-making procedures for the issue being investigated (Kabir, 2016).

A descriptive research design was decided on because it is cost and time-effective and used to gain information that successfully addressed the study objectives. The reason for a descriptive design was to gain the profile of small-scale farmers at the rural household level at Matatiele Local Municipality and to describe the impact of water scarcity on maize farming at the rural household level in Matatiele Local Municipality (Saunders et al., 2023). A descriptive design allows the researcher to use a survey questionnaire, which can be replicated in other populations experiencing the same research problem (Creswell &

Creswell, 2018). The research questions were formulated in such as way that the results could be statistically analysed (Sauders et al., 2019). The results are presented in tables, charts, or graphs (Saunders et al., 2023).

3.6 Sampling method

The inclusion criteria were that the household had to engage in small-scale farming, be literate, could understand the informed consent, were able to converse in basic English that the head had to be willing to participate in the study. Due to budget and time constraints, surveying all the households in Matatiele was not possible. Therefore, a non-random, non-probability, stratified quota sampling method was used (Saunders et al., 2023). Non-probability meant that participants did not have an equal opportunity to participate but that some members were more likely than others to be selected due to the time constraint of time and finances.

The researcher purposefully chose four villages from Ward Five, namely Chibini, Goxe, Mnceba, and Pamla village and two villages from Ward Seven, namely Hillside and New Village. These villages are near the Harry Gwala district area, where they share agricultural and farming land space (Matatiele Local Municipality, 2018). The selection of these specific wards was based on their representation of key rural areas within the Matatiele region, which are particularly impacted by the issues of water scarcity due to their land scaping and food security (Matatiele Local Municipality, 2018).

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Quota and convenient sampling were deemed appropriate as it is often the preferred sampling method when interviews are used for data collection during descriptive surveys (Saunders et al., 2023). Quota sampling is a non-probability sampling method that entails choosing a predetermined number of units, in this case, at least 20 households (Simkus, 2023). As explained, the area was first divided according to the villages, and then the data collectors approached potential participants who met the inclusion criteria non-randomly. The selective households were chosen based on convenience, using a non-random approach. The selection was guided by the premise that the quota sampling would be representative of the target population. (Saunders et al., 2019).

Each of the seven data collection assistants was requested to visit and collect information from at least twenty households to meet the sample size of 140 households. Quota sampling is not free from bias, but data collector assistants were tasked to be consistent in selecting the participants.

3.7 Sample size and sample technique

Determining the sample size, is a critical component of study design in quantitative studies. Sampling refers to selecting a subset of individuals from a larger research population to be included in a study (Martínez-Mesa et al., 2016). The sample for this study consisted of 20 households in each village, a decision based practical and economic constraints. The sample size of 20 people per village was deemed to be large enough to provide reliable insights into the village while still being feasible within the study's resources (Saunders et al., 2023). Furthermore, the sample size ensures that the findings can be generalised to the larger population of households in each village, supporting the reliability and validity of the conclusions (Martínez-Mesa et al., 2016; Saunders et al., 2023). Achieving an optimal equilibrium between the size of the sample and the available resource for a study is crucial to guarantee the reliability and generalisability of the research findings to the larger population from which the sample was selected (Martínez-Mesa et al., 2016). Academic researchers frequently employ statistical computations and deliberations regarding research objectives and available resources to ascertain the most suitable quantitative sample size for their study (Saunders et al., 2023).

Sample size in non-probability sampling techniques depends mostly on the research objectives (Saunders et al., 2023). Seven data collection assistants were trained to collect information. The researcher decided on a non-probability sample size of 140 households due to financial and time constraints. The data collection assistants were tasked to visit and collect information from at least twenty households in each village. The households were chosen on availability of the household head and willingness to participate.

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3.8 Measuring instrument

The use of structured questionnaires to collect information is often implemented when doing a descriptive survey (Saunders et al. 2023). It can be used to gather information that can be translated into numerical information (Saunders et al. 2023). A questionnaire was compiled based on literature. The use of questionnaires as the primary data collection instrument for this study aimed to uncover key issues related to the impact of water scarcity in crop production. A structured questionnaire was developed with the assistance of an external researcher with a doctoral degree in agriculture. The questionnaire consisted of four sections enquiring about demographic, household food security, impact of water scarcity and general questions (Annexure 1).

3.9 Data collection

Data collection is the use of an established strategic and scientific system to obtain and measure information on specific variables which allows the participant to respond to questions (Saunders et al. 2023). In this study data collection referred to the process when the researcher used the measuring instrument to interview the participants to collect the relevant information. The data collection procedure involved face-to-face interviews with the selected household heads. The seven trained data collection assistants went from household to household in the selected villages, enquired if the household head was home, explained the research project and then requested permission to proceed with data collection.

Data obtained from the South African Weather Service (SAWS) were used to discuss and describe the rainfall pattern in the Matatiele area for the period 1993- 2022. The SAWS were contacted via email and were courteously requested if the SAWS could provide the average monthly rainfall data for January 2012 inclusive of December 2022. The SAWS was informed that the data will be used by a student registered at the University of Fort Hare, to complete his mini dissertation.

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3.10 Data analysis

Quantitative data analysis refers to the systematic examination and interpretation of numerical data to gain relevant insights, make conclusions, and test hypotheses within research or problem-solving endeavours (Mohajan, 2021). Data analysis encompasses a variety of mathematical and statistical methodologies aimed at condensing, structuring, and examining datasets, rendering it suitable to explore interconnections, regularities, and tendencies inherent in the data (Saunders et al. 2023). Academic researchers frequently utilise statistical software and tools to conduct descriptive statistics, which include metrics such as standard deviation, median, and mean, to provide a concise data summary (Saunders et al. 2023). Inferential statistics, including t-tests, ANOVA, regression analysis, and chi-square tests, are employed to make predictions or examine hypotheses (Saunders et al. 2023).

The primary objective of quantitative data analysis is to convert unprocessed data into practical information, facilitating decision-making based on evidence and producing empirical discoveries that enhance comprehension of phenomena (Saunders et al. 2023). Data was captured from the questionnaire into Excel by two independent data capturers to

ensure accuracy. The entries were cross-checked and compared to confirm consistency and eliminate discrepancies. The cleaned data was analysed using Statistical Package for Social Sciences (SPSS) and EpiInfo6 statistical packages. Categorical data (nominal and ordinal) and ordinal data for research objective one, two and three, was analysed using descriptive statistics. Frequency tables were constructed, and data is presented in tables and graphs in Chapter four.

3.11 Reliability and validity

The quality and rigour of quantitative research are ensured by incorporating two fundamental concepts: reliability and validity. Reliability pertains to the degree of consistency and stability a measurement exhibits, both in terms of its temporal consistency through time and consistency across diverse conditions (Saunders et al. 2023). In the realm of quantitative research, the reliability of an instrument or measurement tool is determined by its ability to consistently yield comparable outcomes when administered repeatedly to a homogeneous group or population while maintaining a consistent set of conditions (Saunders et al. 2023). There exist several approaches to evaluating reliability, such as test-retest reliability, which involves administering the same measure to participants at two distinct time points to assess consistency, and internal consistency reliability, which examines the level of agreement among different items within a scale or questionnaire using methods like Cronbach's alpha (Polit & Beck, 2021). The importance of high reliability lies in its capacity to ensure that the data obtained effectively and adequately reflects the underlying construct being assessed (Polit & Beck, 2021). This minimises measurement error and enhances the study's overall credibility.

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Validity pertains to how a measurement tool or instrument accurately assesses the intended notion or construct it is designed to evaluate (Polit & Beck, 2021). In quantitative research, the attainment of validity refers to the extent to which the obtained findings accurately and faithfully depict the phenomena being examined (Polit & Beck, 2021). Academic researchers employ different forms of validity. One example is content validity, which examines the extent to which the measurement tool comprehensively covers all dimensions of the concept under investigation. Another is construct validity, which appraises the degree to which the instrument acuurately measures the theoretical construct it aims to depict (Polit & Beck, 2021). Criterion validity is the assessment of the correctness of a measurement tool by comparing it to a well-established gold standard (Polit & Beck, 2021). On the other hand, convergent and discriminant validity require the

examination of the links between the measure and other variables to confirm its expected linkages (Polit & Beck, 2021). The establishment of validity holds significant importance within the realm of quantitative research, as it guarantees the reliability and trustworthiness of the findings (Polit & Beck, 2021). A valid measure is one that accurately assesses the intended construct, thus increasing the likelihood of yielding valuable insights and supporting valid conclusions. To verify the quality of their quantitative study, researchers must establish both reliability and validity. To establish validity, the student requested an experienced person with a PhD in agricultural economics to evaluate the questionnaire for validity and reliability. The pre- and post-questionnaire tests used to determine the reliability coefficient were not implemented as this is only a mini dissertation.

A pilot study was done by seven data collection assistants, one by each of the data collection assistants. The reason for this small pilot study was merely to ensure that the data collection assistants were competent and confident to explain and obtained informed consent from the participants. Moreover, that they understood how to collect information using the semi structured questionnaire. Content validity was ensured by requesting a specialist in the field to assist in critically evaluating the questionnaire. Reliability and validity of the information was further ensured by double capturing and analysing the information by independent people.

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3.12 Ethical considerations

The study was presented to the Department of Geography and Environmental Sciences and, after approval, to the Research Ethics Committee of the University of Fort Hare. The proposal was approved, and the following ethical clearance number was allocated: MAZ011SJIK01 (Annexure 2). The informed consent was explained to the potential participant in English and in IsiXhosa and written informed consent was obtained (Annexure 3).

The University of Fort Hare's ethical committee was approached to obtain approval for the study. Respondents were requested to participate in the study after it was explained to them, and they had time to ask questions and make a voluntary decision to participate. The main ethical principles that were adhered to include the concept that respondents are human subjects with the right to make autonomous, voluntary decisions to participate in a study; the benefits and risks of participating; and justice, which emphasises the need for fairness when conducting the research.

In this case, the respondents were verbally informed about the study. After that, they were given the informed consent form to read. The informed consent was in English and explained in isiXhosa if required. Sufficient time was given to ask questions if they needed clarification on the study. Once all issues regarding the informed consent were clarified, the respondent was requested to sign the informed consent. One copy of the informed consent was given to the participant to keep, and one copy was filed in a separate file, away from the respondent's completed questionnaire, to ensure confidentiality.

Research participants were informed that they would not be subjected to harm in any way whatsoever, whether they agreed to participate or refused to participate (Larkin et al., 2008). Participants were assured that all the information they shared would be kept confidential and that responses could not be associated with any specific participant (Kamanzi & Romania, 2019). Although the data collection assistants knew the participants, anonymity was ensured because no names were requested on the questionnaires (Nzimakwa, 2017). Participants were assured that individual questionnaires were only available for scrutiny by the data collector assistants and the data capture. Questionnaires were kept in a safe place and are stored according to research guidelines for five years. Respect and honour for the dignity of research participants were always prioritised and adhered to during the engagement with participants (Larkin et al., 2008). Participants were informed that participation was voluntary, and that they could withdraw at any time from the study without penalty. No form of compensation to participate in the study was given. Given the potentially sensitive nature of the questions, participants were assured of confidentiality and anonymity in all data handling. To address any distress caused by discussing stressful life experiences, participants were offered access to support services, including referrals to local counseling centers or social support organizations. The study adhered to ethical principles outlined by the Declaration of Helsinki and the guidelines of the University of Fort Hare's Research Ethics Committee, ensuring compliance with internationally recognized research standards.

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3.13 Chapter Three summary

Chapter three explained the research methodology and the research methods used to collect data for analysis. The researcher developed a structured questionnaire and used seven data collection assistants to collect information from 140 households in two wards in

the Matatiele Local Municipality and the results were presented in Chapter Four. A descriptive cross-sectional design within a quantitative approach was followed to meet the objectives. A questionnaire was used to collect the data. Rainfall data was obtained from the SAWS for discussion in Chapter Four. The finding of the study will be discussed in Chapter Four.



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Results

Chapter Four-Results

4.1 Introduction

The purpose of Chapter Four is to present the results derived from the information collected from the participants. Sociodemographic information was collected to demonstrate the background of the participants. Questions directly related to water scarcity and small-scale maize farming were inquired about. Participants were also asked about coping mechanisms used by small-scale farmers during time of water scarcity. Categorical data are presented in frequencies and percentages. Figures and tables are used to depict and describe the results. The rainfall data received from the DWS and SAWS is described and discussed.

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4.2 Demographic information

Slightly more participants were female (53.6%), and most (80%) were older than forty-five years. Very few (3.6%) were youth younger than thirty-five. More than two-thirds stated that the highest education they completed was primary school (65.7%), and only one participant completed tertiary education. Nearly half (48.5%) of the participants had less than ten years of farming experience, and 36.4% reported having more than twenty-one years of experience in farming. Nearly two-thirds (60.7%) stated that they are farming full-time. (Table4.1).

Table 4.1 Demographic data of participants

Category	Subcategory	n/N	%
Age	< 25 years	2/140	1.4%
	25-34	3/140	2.2%
	35-44	23/140	16.4%
	45-54	21/140	15%
	55-65	48/140	34.3%
	>65	43/140	30.7%
Gender	Male	65/140	46.4%
	Female	75/140	53.6%
Education	Primary school	92/140	65.7%
	Secondary school	47/140	33.6%
	Tertiary education	1/140	0.7%
Years of farming experience	< 5 years	37/140	26.4%
	5 - 10 years	31/140	22.1%
	11 – 15 years	10/140	7.2%
	16 – 20 years	11/140	7.9%
	21 – 25 years	20/140	14.3%
	> 25 years	31/140	22.1%
Full or parttime farming	Fulltime	85/140	60.7%
	Parttime	55/140	39.3%

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4.3 Rainfall patterns

The rainfall data was obtained from SAWS and are described and discussed in Table 4.13, to bring it in relation with the responses from the participants. The pattern in the Matatiele area highlights the unpredictable fluctuations observed annually (Figure 4.1). From 1993 to 2002, there was a notable variation in the annual rainfall, with significant fluctuations observed between 470.7 millimetres and 1135 millimetres. The average yearly precipitation throughout this timeframe was roughly 727.8 millimetres. Notably, 2015 was the driest year recorded, while 2022 shows a dramatic contrast as the wettest. Notably, while comparing the average precipitation levels across two intervals, specifically from 1993 to 2007 and from 2008 to 2022, no huge variations could be observed. The earlier period exhibits a mean annual rainfall of 792.4 millimetres, while the latter demonstrates a slightly lower average of 753.2 millimetres per year. Upon describing the data, it becomes apparent that July constantly exhibits the lowest precipitation levels, with an average rainfall of only 13.7 millimetres per month. (Table 4.2).

In contrast, January consistently is the month with the highest precipitation, with an average of 140.8 millimetres every month. May, June, and July consistently exhibit the lowest levels of precipitation, with a discernible rise in rainfall occurring from August onward. Significantly, the culmination of this escalation occurred in January, exhibiting a noteworthy increase by a factor of ten, from 13.97 millimetres per month to 140.9 millimetres. The rainfall pattern in Matatiele demonstrates its unpredictable characteristics, with specific years experiencing a prolonged absence of measurable precipitation for up to four consecutive months, as observed in 2022. (Table 4.2). Conversely, other years, such as 1993, 1994, 1995, 1997, 2002, 2004, 2007, 2012, and 2016, have a consistent distribution of rainfall throughout each month of the year. (Table 4.2).

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Table 4.2 Rainfall pattern 1993-2022

Monthly and total annual rainfall (horizontally) and vertically total rainfall for each month of the year from the year 1993-2022 in mm.

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	MEAN
1993	50.6	203.7	111.3	33.7	1.8	0.1	0.4	15.2	8.7	114.5	70.1	170.7	780.8	65.1
1994	109.1	79.2	128.9	18.4	2	5.2	49.9	11.9	0.2	32.7	18.3	92.8	548.6	45.7
1995	132.4	60.7	88.1	7.7	6.1	44.8	1	3.8	22.5	54.8	91.9	184.8	698.6	58.2
1996	197.7	194.6	106.8	59	0	4.5	53.5	6.3	6.8	70.4	82.3	163.8	945.7	78.8
1997	174.3	142.1	144.7	62.9	20.5	97.9	18.4	20	15.9	31.2	81.8	78.2	887.9	74.0
1998	185.8	154.3	131.2	4.9	0	0	0	21.9	9.4	34.2	102.5	90.6	734.8	61.2
1999	134.8	138.2	123.7	17.6	16.5	0	1.8	0	4.3	50.1	90.4	163.2	740.6	61.7
2000	155.9	51.2	224	56.7	39.5	0	0	0	62.4	27.1	59.9	112.8	789.5	65.8
2001	140.8	89.2	134.4	66.9	0	4.6	7.5	38.8	92.1	118.1	121.2	173.2	986.8	82.2
2002	121.6	42.9	65.4	28.5	45	14.4	47.3	57.7	43.5	37.8	21.3	155.3	680.7	56.7
2003	118.9	60.3	90.5	59.5	10.7	5.3	0	12.6	36.7	10.6	60.6	37.8	503.5	42.0
2004	143.2	135.4	93.3	17.9	19.6	18	69.7	24	57.7	63.6	189.1	146.2	977.7	81.5
2005	115	95.4	158.4	20	7.3	2.5	3.3	31.5	4.3	77.5	107.8	32.7	655.7	54.6
2006	205.2	156.3	36.7	48.1	12.5	3.5	0	90.4	88.8	166.3	147.8	164.2	1119.8	93.3
2007	184.6	87.4	96.5	67.7	2	53.5	4.7	4.2	21.7	102.5	122.1	88.7	835.6	69.6
2008	103.3	87.6	94.9	70.2	2.2	33.8	0	0	56	33	83.2	182.1	746.3	62.2
2009	126.6	169	48.3	19.6	31.8	7.5	0	39.3	37.9	115.6	75.7	30	701.3	58.4
2010	120.4	74.2	37.8	85.7	2.5	21	0	0	0	85.7	115.4	0	542.7	45.2
2011	134	127.2	115.8	77.1	36.8	20.3	50.2	20.9	0	30.7	80.5	124.2	817.7	68.1
2012	258.8	113.9	119.5	13.8	3.5	13	14.2	89.5	51.8	61.6	190.2	171.2	1101	91.8
2013	59.8	96.6	150.4	83.4	8.1	7.5	0	11.5	2	40.9	87.3	130.2	677.7	56.5
2014	116.2	60.2	86.5	25.2	0	0	0	1	5.8	53.1	107.9	201.2	657.1	54.8
2015	112.4	72.1	92.2	11.6	0	4	16.5	0	12	17.8	37.3	94.8	470.7	39.2
2016	139.7	100.7	73.7	26.8	25.9	1.1	33.8	15.5	35.2	22.1	101.9	158.6	735	61.3

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2017	98.6	190	88.6	15.5	31.3	0	0	6.3	2.5	98.2	99.9	84.1	715	59.6
2018	164.7	162.9	92.3	17.7	15.5	0	13	69.8	19.8	20.7	27.7	77.4	681.5	56.8
2019	135.6	193.1	188.6	82.2	9	0	0	0	6	21.7	34.4	113.1	783.7	65.3
2020	148	128.2	90.2	65	0	0	0	0	11.8	87.7	61.4	145.2	737.5	61.5
2021	145.8	49.1	31.5	34	0	63.7	0	58.8	40.8	64.1	81.7	224.9	794.4	66.2
2022	191.6	200.6	164.7	106.7	69.2	0	15.8	4.5	34.4	107.6	87	152.9	1135	94.6
Total	4225.4	3516.3	3208.9	1304	419.3	426.2	401	655.4	791	1851.9	2638.6	3744.9		
Mean /month	140.8	117.2	107.0	43.5	14.0	14.2	13.4	21.8	26.4	61.7	88.0	124.8		

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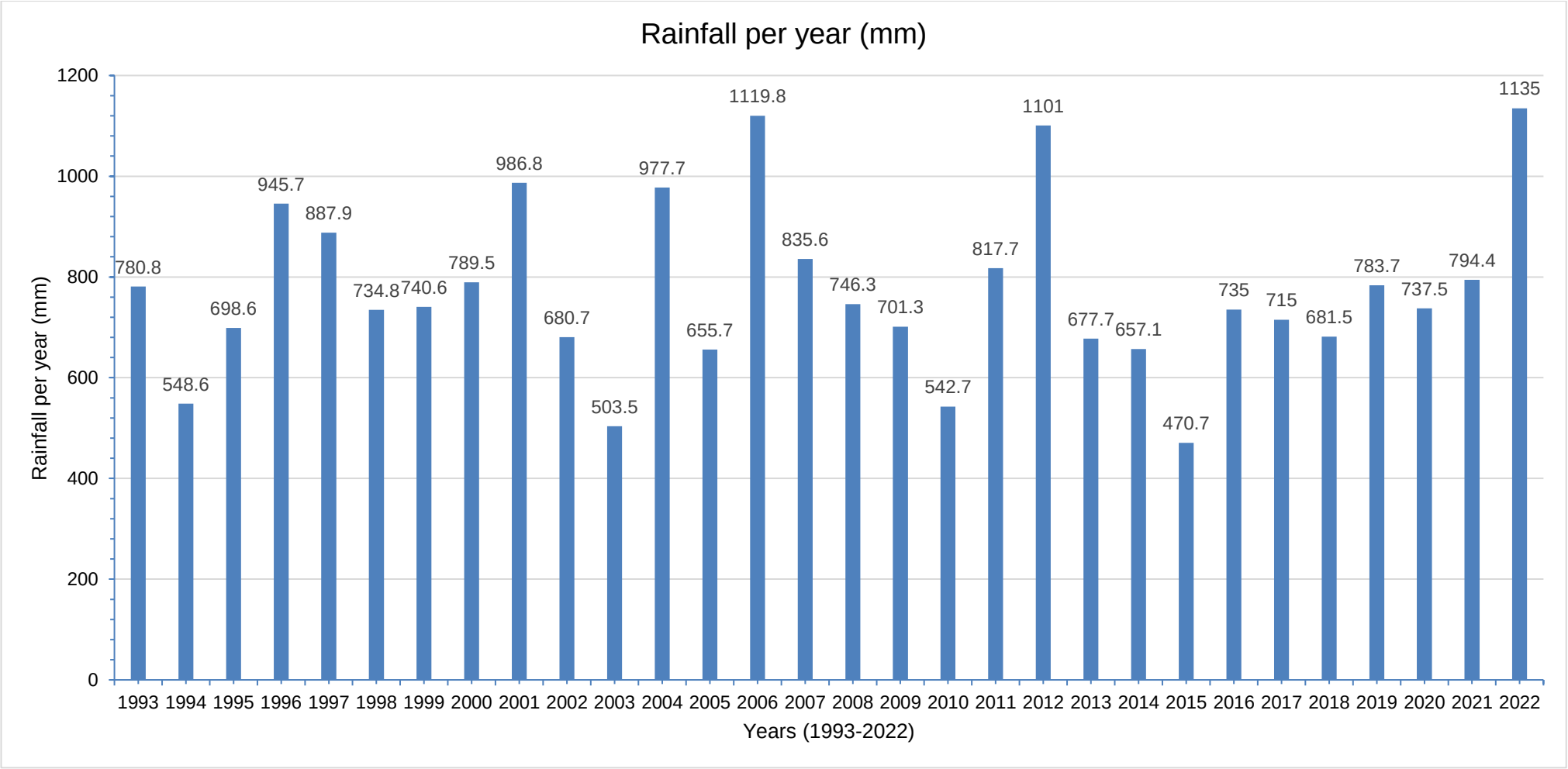
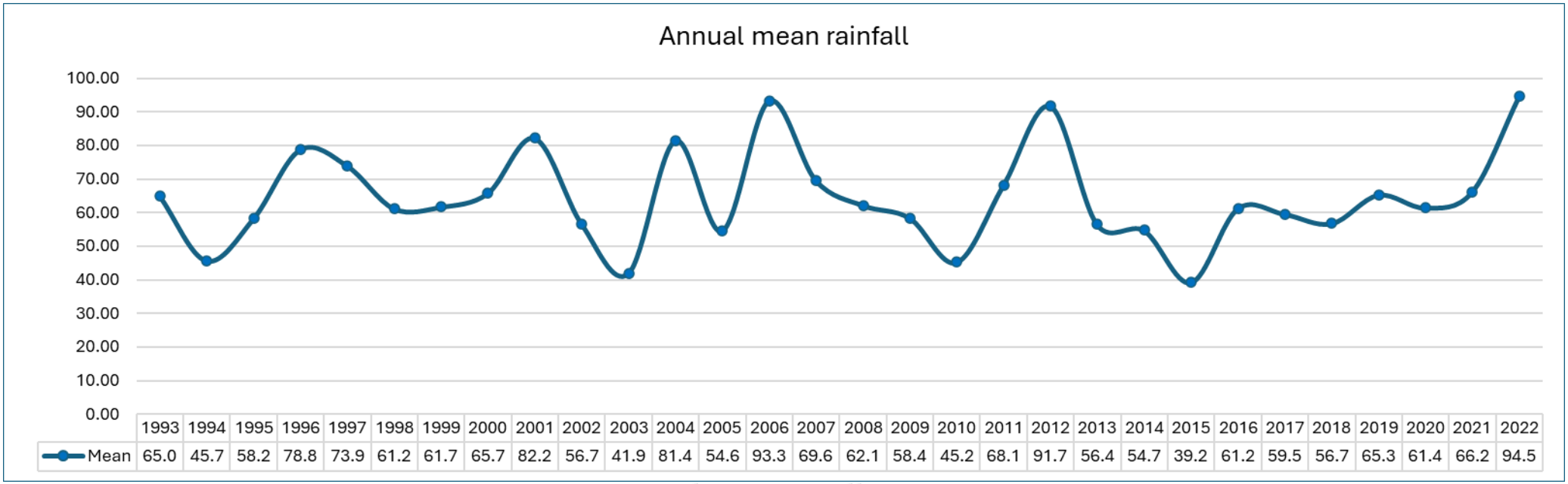


Figure 4.1 Total annual rainfall for years 1993-2022 of the precipitation of Matatiele Local Municipality.

The annual mean rainfall demonstrate variation, with certain years like 2006 and 2012 being exceptionally wet, while years like 2003 and 2014 being dry. (Figure 4.2)



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Mean	65.0	45.7	58.2	78.8	73.9	61.2	61.7	65.7	82.2	56.7	41.9	81.4	54.6	93.3	69.6	62.1	58.4	45.2	68.1	91.7	56.4	54.7	39.2	61.2	59.5	56.7	65.3	61.4	66.2	94.5

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Figure 4.2 Total annual mean rainfall for years 1993-2022 of the precipitation of Matatiele Local Municipality.

4.4 Land ownership, size, and water source

The majority (88.6%) of the participants owned their land. The rest of the land they used was classified as communal (5.9%), cooperative (2.4%) or belonged to the government (2.4%). Most (64.3%) of the participants farm on 0.5 hectares or one hectare of land (31.4%). The majority (73.6%) of the participants stated they access an individual water source, 18.6% access a communal water source and only 5.7% access a water source provided by the government. For the purpose of this study communal water source refers to a water source in the village, some distance from the household where people collect here water from. The source can be a well or a borehole. Co-operative water source refers to a water source where more than household has contributed to set up a borehole or dig a well and these households share the water only amongst themselves. Government water refers to water provided for by the municipality, mostly though a tap in the yard. Individual water source, as defined in this study, refers to the issue where an individual from the household must walk some distance to a dam or a river to collect water for the household. It does not refer to a private borehole. Slightly more than half (58.6%) of the participants reported that the slope of their land was steep, thus water will run down, off their land, if it rains. (Table 4.3).

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Table 4.3 Land ownership, size, and water source

Category	Subcategory	n/N	%
Land ownership	Communal	9/140	5.9%
	Cooperation	3/140	2.4%
	Government	3/140	2.4%
	Individual	124/140	88.6%
	Individual & cooperation	1/140	0.7%
Size of the land used	0.5 hectare	90/140	64.3%
	1 hectare	44/140	31.4%
	2 hectares	5/140	3.6%
	4 hectares	1/140	0.71
Slope of the farm	Flat	58/140	41.4%
	Steep	82/140	58.6%
Source of water	Communal	26/140	18.6%
	Cooperative	2/140	1.4%
	Government	8/140	5.7%
	Individual (river, dams)	103/140	73.6%
	Individual and communal	1/140	0.71%

4.5 Food insecurity

Participants were asked whether farming was their sole food source, and 67.1% said they live mainly from the income and produce from farming. The 32.9% who did not live mainly from farm produce stated that they had either full- or part-time jobs or received food parcels from the government. Nearly two-thirds (60.7%) of the participants felt that their household's essential daily food intake had improved recently. (Table 4.4).

The researcher inquired whether the participant or any household members ever skipped a meal because there was insufficient money to buy food over the last 12 months. Nearly two-thirds (67.9%) of the participants responded that none of their household members had skipped a meal in the last 12 months due to a lack of income. On the other hand, 8.6% reported that they or their family skipped a meal at least once a week due to insufficient income. Furthermore, the researcher inquired whether anyone in the household had become ill because of insufficient food in the past 12 months. A small proportion (5%) of the participants responded that people in the household got ill due to insufficient food. (Table 4.4).

Participants were asked if they had to ration the size of children's meals due to insufficient food availability. Seventy per cent responded that they did not need to ration children's meals, but 8.6% had to ration children's meals at least once a week. Most (77.1%) of the participants responded that children in their household never had to go a whole day without food because of a lack of money to buy food. Sadly, 7.1% responded that children had to go without food for a whole day at least once a week. Another question asked whether the participants have ever been worried about running out of food in a particular year in the past few years. Two-thirds (67.1%) expressed concern that they might have run out of food, and most (55.3%) of those were worried about insufficient money; others (18.1%) were concerned about not having enough agricultural produce. (Table 4.4).

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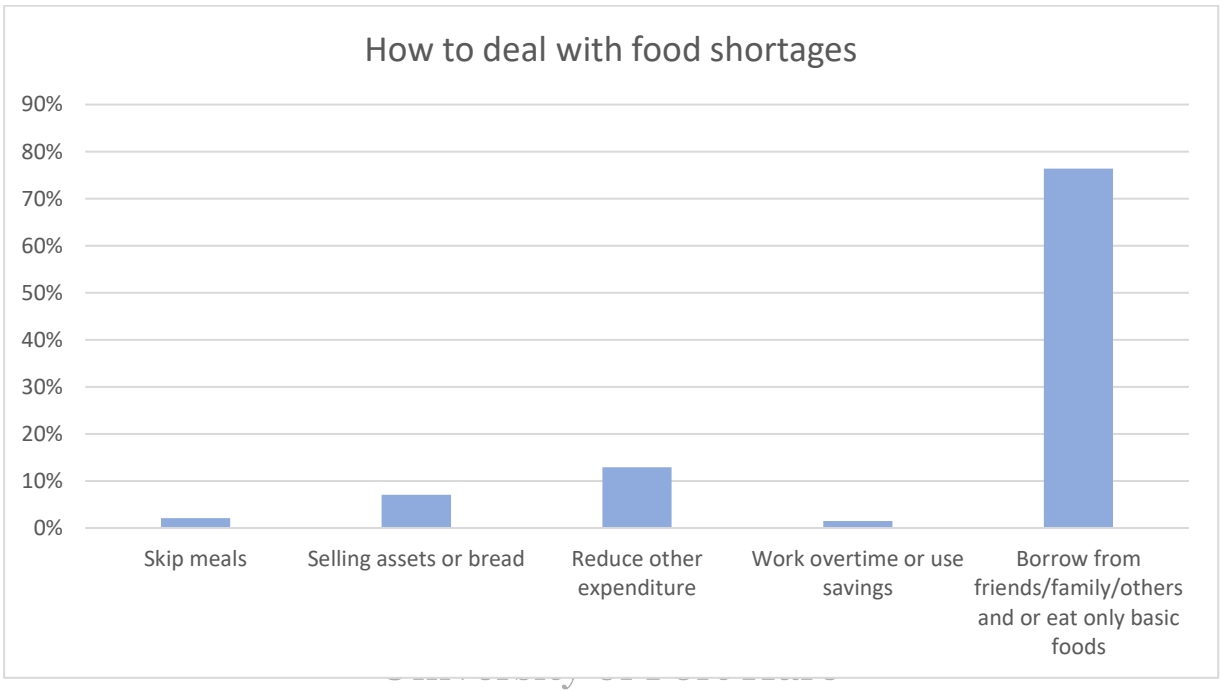
Table 4.4 Food insecurity

Category	Subcategory	n/N	%
Is farming produce the major source of food?			
	Yes	94/140	67.1%
	No	46/140	32.9%
If not what else?	Fulltime employed	9/46	19.6%
	Parttime employed	12/46	26.1%
	Government parcels	25/46	54.3%
Has the basic daily food intake of your household improved?			
	Better	85/140	60.7%
	The same	39/140	27.9%
	Worse	16/140	11.4%
Skip a meal due to insufficient money			
	Once a week	12/140	8.6%
	Once a month	8/140	5.7%
	Once in 3-6 months	16/140	11.4%
	Never skipped a meal	95/140	67.9%
	I do not know	9/140	6.4%
Did anyone become ill due to insufficient food?			
	No	133/140	95.0%
	Yes	7/140	5.0%
Did you ration the size of children's meals?			
	Once a week	12/140	8.6%
	Once a month	10/140	7.1%
	Once in 3-6 months	16/140	11.4%
	Never	98/140	70%
	I do not know	4/140	2.9%
Did any of the children ever not eat for a whole day because of lack of money to buy food?			
	Once a week	10/140	7.1%
	Once a month	8/140	5.7%
	Once in 3-6 months	12/140	8.7%
	Never	108/140	77.1%
	I do not know	2/140	1.4%
Were you worried that you would run out of food in the past few years?			
	No	46/140	32.9%
	Yes	94/140	67.1%
If yes, why	Lack of money	52/94	55.3%
	Lack of agriculture produce	17/94	18.1%
	Lack of both	25/94	26.6%

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4.6 Coping strategies

Participants were asked how they cope when they experience food shortages, and most (76.4%) of them stated that they borrow from family, children, and friends or eat only simple and basic food. Some (12.9%) reported that they cut down on their regular health expenditure, while others will skip meals (2.1%), sell assets (7.1%), work overtime, or use their savings (1.5%). (Figure 4.3).



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Figure 4.3 Coping strategies

4.7 Plans for the future

Participants were reminded that climate change affects crop production and increases food prices. They were then asked how they would deal with food shortages and whether they had any plans. Most (83.6%) reported having successive plans when there is a change of climate. Just more than half of the 117 participants who responded positively that they have a plan stated that they would buy water tanks to catch rainwater during the rainy seasons. One participant will build a dam, one will exchange his agricultural crop for farming with chickens, and one will put down fertiliser to prevent erosion during floods, as applying organic fertilisers can be a promising method to mitigate soil erosion by modifying the physical and chemical characteristics of the soil, including macro aggregates, soil organic carbon (SOC) levels, and exchangeable cations (Cui et al., 2023). Two participants said they would hire equipment to irrigate, while 29.1% said they would get water from a river or nearby spring. (Table 4.5).

Table 4.5 Future planning to address water scarcity

Category	Subcategory	n/N	%
Plans in place	No	23/140	16.4%
	Yes	117/140	83.6%
If yes what plans?	Buy water tanks	68/117	58.2
	Built a dam	1/117	0.8
	Use the spring/river for irrigation	34/117	29.1
	Hire/buy water for irrigation	2/117	1.7
	Exchange crop to chickens	1/117	0.8
	Prevent erosion add fertiliser	1/117	0.8
	Request government support	2/117	1.7
	Reduce food consumption	2/117	1.7
	Use savings	6/117	5.2

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4.8 Type of animals and farming system

Cattle were the most prevalent, as at least twenty participants had cattle on the land, nineteen had small stock, eighteen had poultry, and fifteen had pigs. Only two participants stated that they had horses on their land, and eight stated that they had no animal. (Table 4.6).

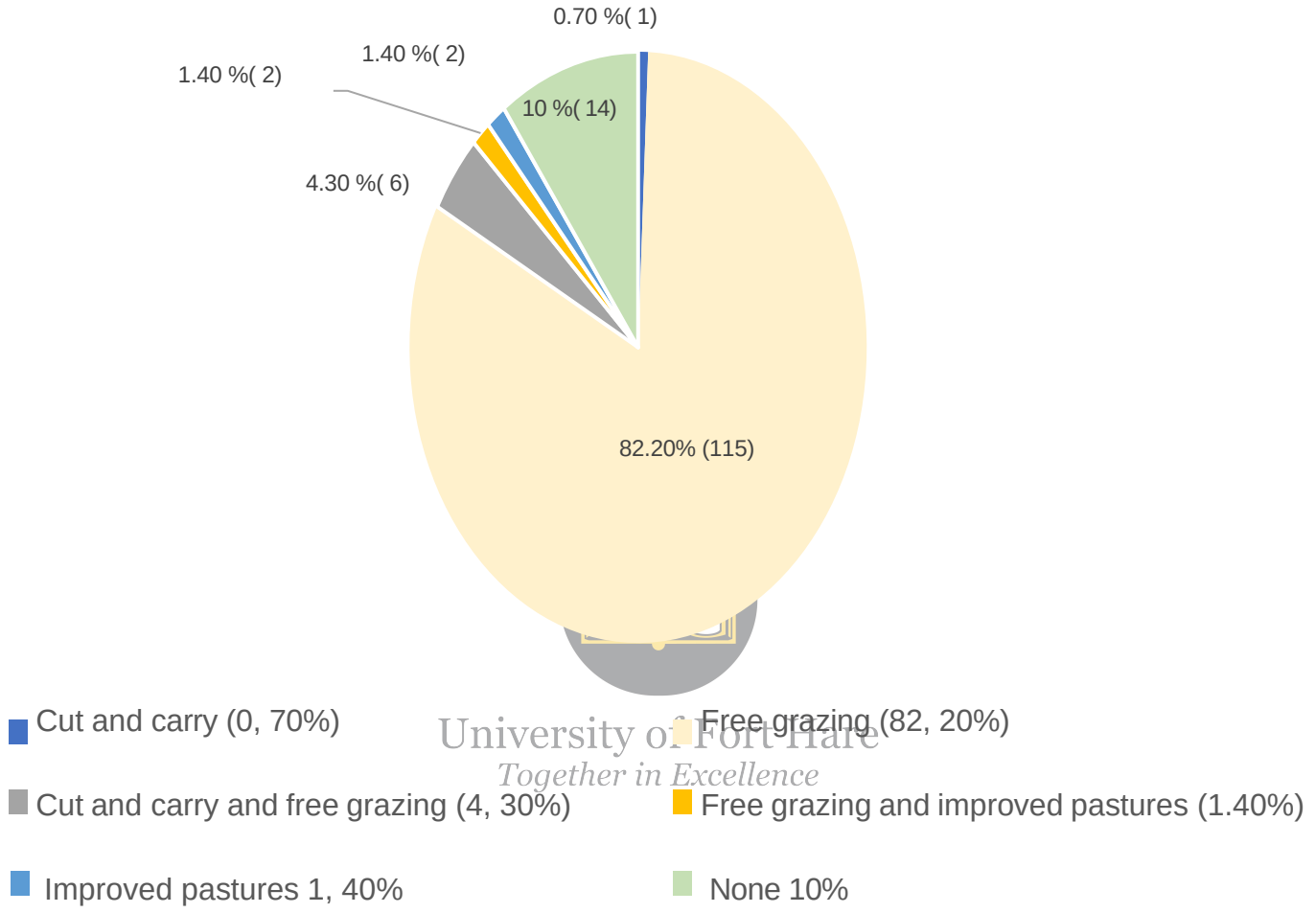
Table 4.6 Type of animals

Category	Subcategory	n/N	%
Types of animals	Cattle	20/82	24.4%
	Small stock	19/82	23.2%
	Poultry	18/82	21.9%
	Piggery	15/82	18.3%
	Horse	2/82	2.4%
	None	8/82	9.8%
Combination of animals on the land			
	Beef, Dairy, Piggery,	1/140	0.7%
	Beef, Dairy, Piggery, Poultry, Small stock	1/140	0.7%
	Beef, Dairy, Small stock	1/140	0.7%
	Beef, Piggery	1/140	0.7%
	Beef, Piggery, Poultry	2/140	1.4%
	Beef, Piggery, Poultry, Small stock	13/140	9.3%
	Beef, Piggery, Small stock	3/140	2.1%
	Beef, Poultry	6/140	4.3%
	Beef, Poultry, small stock	18/140	12.9%
	Beef, Small stock	22/140	15.7%
	Dairy Piggery, Poultry,	1/140	0.7%
	Dairy, Piggery Poultry, Small stock	2/140	1.4%
	Dairy, Poultry, Small stock	1/140	0.7%
	Dairy, Small stock	1/140	0.7%
	Horse, Small stock	1/140	0.7%
	Horses, Poultry, Small stock	1/140	0.7%
	None	8/140	5.7%
	Piggery, Poultry,	3/140	2.1%
	Piggery, Poultry, Small stock	9/140	6.4%
	Piggery, Small stock	3/140	2.1%
	Poultry	10/140	7.1%
	Poultry, Small stock	25/140	5.0%
	Small stock	7/140	5.0%

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4.9 Types of farming system used for grazing

Most (82.2%) participants used the free grazing method for their animals. (Figure 4.4).



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Figure 4.4 Type of farming system

4.10 Types of crops

Participants farm with sixteen different types of agricultural products. Maize (59), cabbage (45) and spinach (43) are the most popular produce, as mentioned by the number of participants. Potatoes (27) and carrots (21) are also preferred agricultural produce, as mentioned by the participants. Lettuce and cornflower are the least favourite produce farmed by the participants. (Table 4.7).

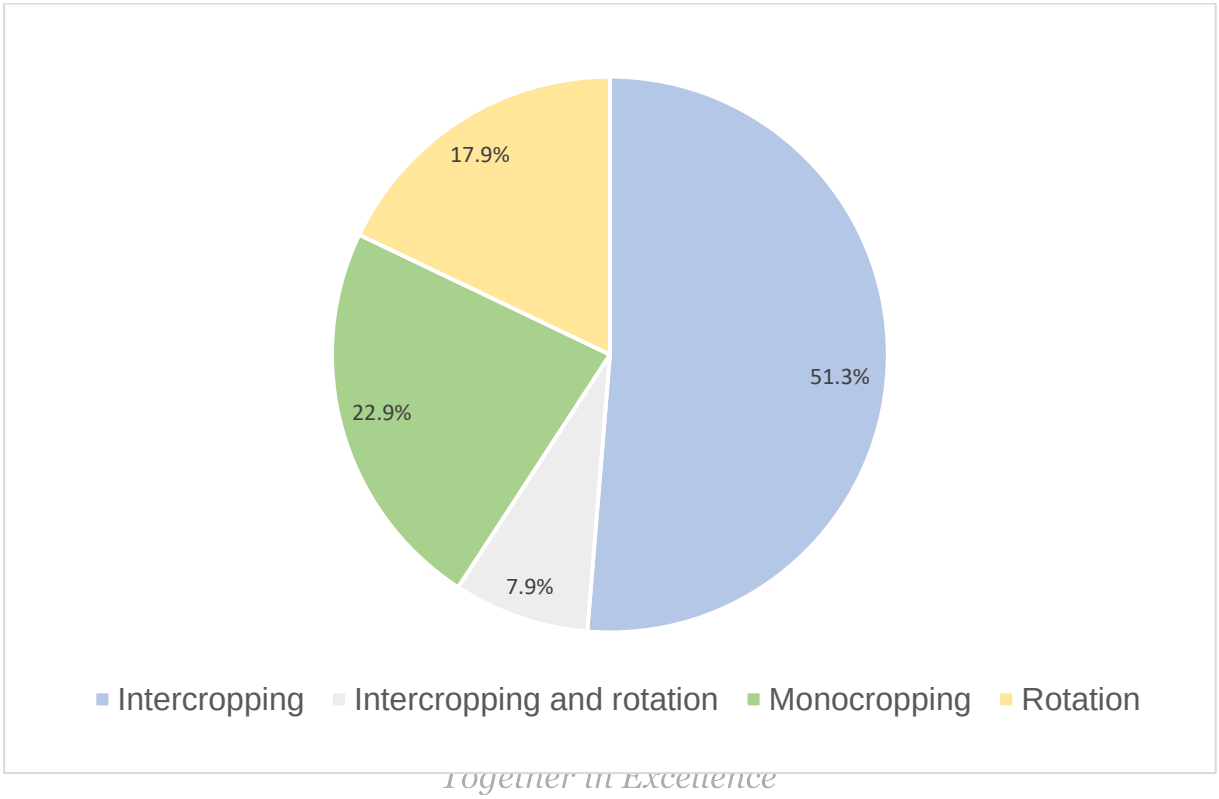
Table 4.7 Type of agricultural produce

Produce	# of participants	Produce	# of participants
Beans	14	Lettuce	1
Beetroot	14	Maize	59
Broccoli	2	Onion	6
Butternut	2	Potatoes	27
Cabbage	45	Pumpkin	8
Carrots	21	Spinach	43
Cornflower	1	Tomatoes	8
Green peppers	10	Turnips	4

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4.11 Types of cropping systems

More than half (51.3%) of the participants stated that they use only intercropping. Monocropping was applied by 22.9% of participants, and 17.9% used rotation as a cropping system. (Figure 4.5).



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Figure 4.5 Cropping systems

4.12 The use of fertilisers

Sixty-four participants stated that they do not use any fertiliser. More than half (53.9%) of the seventy-six participants who stated that they do use fertiliser, used natural manure or animal dung. Roundup, which is an herbicide, was mentioned by 14.4%. The rest of the participants use different combinations of nitrogen-phosphorous-potassium (NPK), nitrogen-ammonium-N-nitrate-N-dolomitic lime-calcium and Magnesium (LAN), or diammonium phosphate (DAP) fertilisers. (Table 4.8).

Table 4.8 The use of fertilisers

Category	Subcategory	n/N	%
Do you use fertilisers	Yes	64/140	45.7%
	No	76/140	54.3%
If yes what type of fertiliser	Yes, DAP Fertilizer	1/76	1.3%
	Yes, GPS Fertilizer	3/76	4.0%
	Yes, GPS fertilizer, round up	1/76	1.3%
	Yes, LAN	2/76	2.6%
	Yes, LAN, Manure	3/76	4.0%%
	Yes, Manure	41/76	53.9%
	Yes, Manure, Galvan	1/76	1.3%
	Yes, Manure, NPK	3/76	4.0%
	Yes, NPK	3/76	4.0%
	Yes, NPK, LAN	1/76	1.3%
	Yes, NPK, LAN, Organic fertilizer	1/76	1.3%
	Yes, Organic fertilizer	3/76	4.0%
	Yes, OSP	1/76	1.3%
	Yes, Round up	11/76	14.4%
	Yes. HPP, Row mix	1/76	1.3%

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4.13 Nature of soil

Participants were asked to state the colour and the type of soil that is mostly found on their land. Red soil was the most (61.7%) prevalent colour of soil, 16.4% had dark brown, and 8.6% had black soil. Most (73.6%) reported loam soil, 13.6% had clay soil, and 8.6% had sandy-clay-loam soil. Very few reported that the type of the soil was sandy or silt. Most (75.7%) of the participants reported that they have good-quality soil. Only 6.4% felt that the quality of their soil could have been better. (Table 4.9).

Table 4.9 Soil properties

Category	Subcategory	n/N	%
Colour of soil	Black	12/140	8.6%
	Grey soil	6/140	4.4%
	Red soil	94/140	67.1%
	Black and Red soil	2/140	1.4%
	Dark brown	23/140	16.4%
	Dark brown and Red soil	1/140	0.7%
	Grey and Red soil	2/140	1.4%
Soil texture	Clay soil	19/140	13.6%
	Loam soil	103/140	73.6%
	Sandy soil	2/140	1.4%
	Loam soil & Clay soil	1/140	0.7%
	Sandy-clay loam	12/140	8.6%
	Silt & Clay soil	2/140	1.4%
	Silt & Loam soil	1/140	0.7%
Rate the soil quality	Good	106/140	75.7%
	Average	25/140	17.9%
	Poor	9/140	6.4%

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4.14 Drought and crop production

Participants were asked whether drought has negatively affected their crop production over the ast 10 years and 78.6% agreed that drought has negatively affected crop production over the last ten years. When participants responded to the question, whether they in general observed positive differences in crop production over the last 10 years, less than half (45.7%) of the participants agreed. Only one-third (34.3%) felt that there was sufficient water for crop growth and animal sustainability on their land. Moreover, 82.9% agreed that water scarcity affected crop production and led to lesser income. (Figure 4.5).

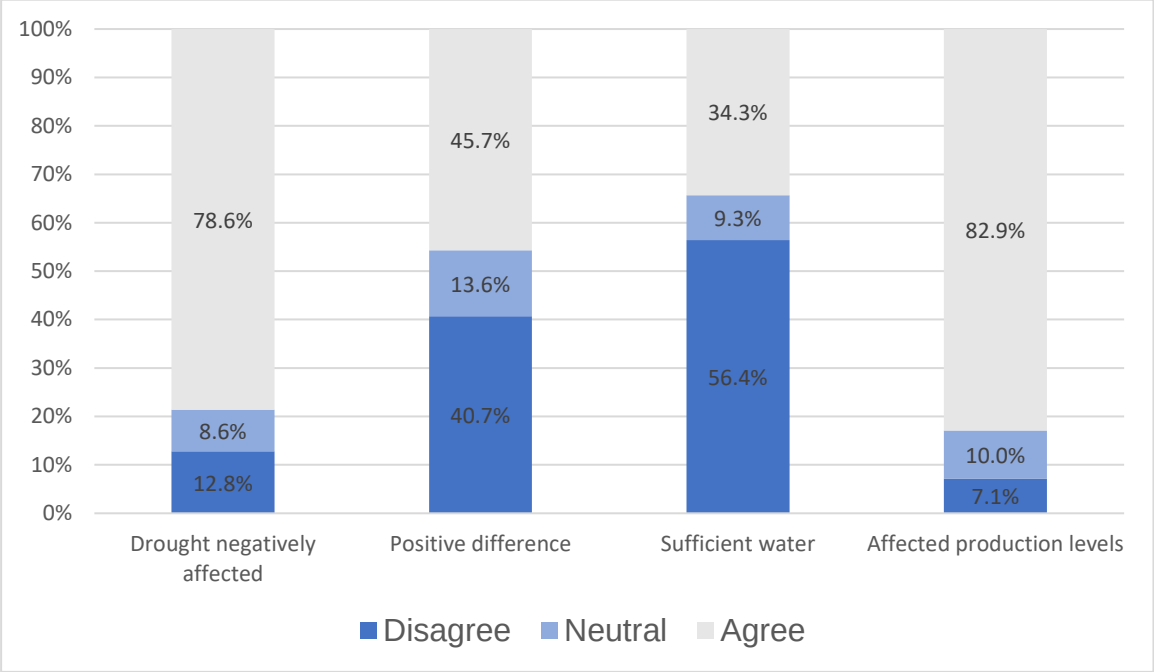


Figure 4.5 Drought and crop production

4.15 Maize farming constraints

Participants were asked to comment on the significant constraints experienced by them related to the weather or crop production. The main categories of constraints mentioned by the participants were related to climate change or natural disasters like floods, droughts, storms, and snow. Capital was also mentioned as a constraint as they cannot erect fencing or buy animal feeds or seedlings to procure agricultural produce, when they do not have sufficient money. Moreover, participants reported that moles, insects, worms, and weeds threaten their produce. The 140 participants raised a combination of challenges—the primary constraint was access to water and water scarcity as this challenge was mentioned fifty-two times. The water challenge goes in hand with the drought, which was mentioned twenty-four times by the participants. The lack of fencing was mentioned twenty-five times, by farmers. Stray animals from neighbours enter their yards and destroy their crops if there are no fence around their property. (Table 4.9).

Moreover, participants complained of stock theft (3) and challenges with insects (16) and moles (18). Worms (5) and weeds (9) were reported as an ongoing struggle as herbicides and pesticides are expensive and therefore the problem cannot be easily addressed. Lack of/malfunctioning of major equipment (9) like tractors and water tanks (2) also restrict small-scale farmers from producing good crops. (Table 4.10).

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Table 4.10 Farming constraints

Constraint	# of participants	Constraint	# of participants
Capital	9	Climate change	2
Animal vaccines/med	4	Drought	24
Equipment	9	Erosion	3
Feeds for animals	4	Floods	15
Fencing	25	Frost	1
Tanks for water	2	Natural disasters	1
Tools	1	Snow	11
Poor infrastructure	2	Storm	12
Pesticides	4	Water access & scarcity	52
Seeds/seedlings	6	Insects	16
Theft	3	Moles	18
Infertile soil	2	Weeds	9
		Worms	5

4.16 Government sustainable support

Participants were asked what inputs they wished the government could do to assist them in sustaining the production level or to assist with the water scarcity problems. The 140 participants mentioned different ways they think the government can assist them. From simple things like providing watering cans to expensive equipment like tractors. The need for water supply and irrigation was mentioned fifty-nine times by the participants. Other significant needs, as mentioned by the participants, were seeds (58), fertiliser (47), fencing (34), and tractors (21). Equipment (13) other than tractors, like ploughing instruments and smaller materials and tools, were mentioned by ten participants. There is a need for farmer training skills (19), not only on how to farm but also how to plough and use the tractor. Feeds for livestock (10) and herbicides (5), pesticides (15) and insecticides (1) were also mentioned as ways the government can support the participants. (Table 4.11).

Table 4.11 Government support

Support	# of participants	Support	# of participants
Boreholes	4	Materials & tools	10
Capital	2	Water supply	59
Equipment	13	Feed for livestock	10
Tractors	21	Seed	58
Fence	34	Herbicides	5
Fertiliser	47	Insecticides	1
Funding	7	Pesticides	15
Greenhouse	2	Farmer training skills	19
Infrastructure	3		

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4.17 Provision of additional income

Participants were asked whether they received any other means of income other than selling own produced products. A very small percentage (13.6%) stated that they receive other income. Of the percentage of participants who stated they receive an income 36.8% supplement their income by having a parti time job, 42.1% of the nineteen participants who stated they receive additional income depended on social grants and 15.8% run a spaza shop. (Table 4.12)

Table 4.12 Receiving additional income

Category	Subcategory	n/N	%
Get income from	No	121/140	86.4%
	Yes	19/140	13.6%
	Part time job	7/19	36.8%
	Social grant	8/19	42.1%
	Spaza shop	3/19	15.8
	Relative	1/19	5.3%

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4.18 Future improvement of agricultural farming

Most (80.7%) participants agreed that their current agricultural situation will not improve in the next 10 years. Of the 113 participants who believed that maize farming would not improve 32.7% stated that the main reason would be due to water scarcity or drought and due to the lack of finance (23.9%). (Table 4.13).

Moreover, 27/140 felt that maize farming would improve in the next ten years and gave reasons such as if there is good rainfall and if the government would assist the small-scale farmers financially and with information.

Table 4.13 Would farming improve in the next 10 years?

Category	Subcategory	n/N	%
	Water scarcity or drought	37/113	32.7%
	Lack of finance	27/113	23.9%
	Climate change	16/113	14.2%
	Youth not interested (lazy)	17/113	15.0%
	Corruption & poor service from government	6/113	5.3%
	Floods or soil erosion	5/113	4.4%
	Infertile soil	5/113	4.4%
	Dedication and good production this far	5/27	18.5%
	Receive assistance form government	7/27	25.9%
	Good rainfall	10/27	37.0%
	Government teaches us about agriculture	5/27	18.5%

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Chapter Four summary

The results demonstrated that most small-scale farmers land is less than 1 hectare and individually owned. Most farmers depend on farming as their major food source, and feel that their basic food intake has improved, with very few skipping a meal or had to ration the size of children's meals. Coping strategies to deal with the immediate problems is essential, and most borrow from family or friends to put food on the table. More than half would like to invest in water tanks to cope with water scarcity. Most participants farm with maize or cabbage. Participants were of the opinion that drought has negatively affected their crop production and water scarcity is a real challenge. Drought, water access and water scarcity are their greatest challenges. Farmers felt that the government could support small-scale farmers by supplying seeds, water and fertiliser. The month of July is the driest month and January the wettest month in the area. Chapter Four presented the results of the findings and Chapter Five will engage in discussions of the findings related to the literature.

Discussion, conclusion, and recommendations

Chapter Five-Discussion, conclusion and recommendations

5.1 Introduction

The issue of water scarcity presents a significant and complex obstacle for small-scale rural farmers, particularly those involved in the cultivation of maize and vegetable crops. This challenge has far-reaching implications since it directly jeopardises food security and the overall sustainability of livelihoods in several locations across the globe. Chapter Five presents discourse and examines the outcomes of contemporary research on the consequences of water scarcity on small-scale rural farmers in conjunction with findings from this study, which evaluated water scarcity and small-scale farming at the rural household level in Matatiele Local Municipality in the Eastern Cape. In addition, we present the coping mechanisms employed by small-scale farmers and propose sustainable approaches that can strengthen resilience in the wake of escalating water-related difficulties.

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5.2 Discussion

The combination of limited educational attainment and skill levels is a barrier to adopting sustainable agricultural practices and enhancing crop yields (Ogisi & BeghoIn, 2023). These factors restrict the ability of rural households to generate revenue and hinder their access to food security. Contrary to the results of Ngarava (2023), who demonstrated that similar proportions of the household heads were male (50.3%) and females (49.7%), this study found that there were more female household heads than males (53.6% vs 46.4%). This study agrees with the results related to the education of the household head in that Ngarava (2023) stated that 35.9% of the respondents completed secondary school, which is similar to the 33.6% found in this study. More than 60% of the small-scale farmers were older than fifty-five, like the ages reported by Chimonyo et al. (2020). Ngumbela et al. (2020) claim that race and gender are correlated with susceptibility to food insecurity and that a significant portion of the population in the Eastern Cape region consists of

impoverished individuals, particularly those of African descent. Additionally, Ngumbela et al. (2020) found that women-led households have a notable prevalence of poverty.

Objective One

Describe and discuss the monthly average rainfall in the Matatiele area between 1993 and 2022

From the data analysed it appears that the rainfall pattern in Matatiele is erratic, but there is a trend in that commonly, the dry months are May to August. The wet months are November through to March. Maize is a product that depends on water. The unpredictable characteristics of the rainfall pattern may make it difficult for small-scale farmers to produce healthy maize crops too much or too little water are both a challenge. Mahlalela et al. (2020) state that a significant portion of the Eastern Cape province in South Africa has been enduring a severe drought since 2015. The drought has had substantial socio-economic ramifications, particularly on the impoverished rural populace. Since 2015, the region has consistently suffered from drought throughout all seasons. Mahlalela et al. (2020) conducted a study on the spring season (September-November) in the Eastern Cape. They found a notable decrease in rainfall and the frequency of rainy days (excluding days with high rainfall) during spring in most parts of the province since 1981.

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Furthermore, Chemura et al. (2022) claim that the statistical reliability of rainfall patterns in the Eastern Cape region is compromised, possibly due to increased intense rainfall events, recurring droughts, and elevated temperatures. Additionally, small-scale farmer communities in this area rely on rain-fed agriculture, which is highly susceptible to the impacts of these dramatic changes in rainfall and temperature (Chemura et al., 2022). The escalation in climatic extremes complicates the relationship between livelihood (maize farming) and climate (Chemura et al., 2022).

Objective Two

Determine the rural households' food security status.

Objective one was to determine and report on rural households' food security status of small-scale farmers in Matatiele. Ngarava (2023) applied the Household Food In-Access Scale (HFIAS) to determine the "effectiveness of indigent support policy on food insecurity in Matatiele Local Municipality" and reported that about 5% of the households are extremely food insecure and 40% are moderately food secure. Cheteni et al. (2020) used

the Household Nutritional Diversity Score (HDDS), and the results indicated that 61% of rural families in the Eastern Cape indicated that most households had sufficient food consumption levels. This study did not use a specific food access scale to determine the household's food status, but the results demonstrate similarity in that 67.9% never had to skip a meal, and 70% never had to ration the size of meals. Moreover, most (77.1%) never went without food for a whole day. Thus, there is evidence of moderate food security as only a few households experience food insecurity in the district.

Objective Three

Determine the effect of water scarcity on rural small-scale crop farming

The second objective was determining the effect of water scarcity on rural small-scale crop farming in Matatiele at the household level. The study conducted by Baleni et al. (2022) established that rural households in the Eastern Cape Province experience water insecurity, leading to adverse impacts on their lives and agricultural activities. According to Apraku et al. (2023), climate change and political-administrative neglect exacerbate water insecurity in numerous rural areas in South Africa. The authors also note that in the Eastern Cape, most rural residents still rely on dams, rivers, and streams for their domestic and agricultural water needs. Apraku et al. (2023) documented the origin of rural households' water sources and reported that 51% of respondents reported accessing water from community taps, streams, or rivers. In addition, 41% of the respondents reported that their major water sources are from wells or boreholes, harvested rainfall, municipal water trucks or dams (Apraku et al., 2023).

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Similarly, when asked about maize farming constraints in our study, several participants reported that water access and water scarcity are their most significant constraints when farming maize and other agricultural produce. They do not have municipality water and most access an individual water source, 18.6% access a communal water source and only 5.7% access a water source provided by the government.

Maize farming is one of the leading agricultural products reported by the participants in our study but are hugely affected by water scarcity. Similar, to the results published by Greenberg et al. (2022) the small-scale farmers in this study engaged in various agricultural products such as maize, cabbage, potatoes, spinach that can be easily irrigated by water cans during water scarcity.

Objective Four

Coping mechanisms to deal with water scarcity and food insecurity

The third objective of this study was to identify coping mechanisms to deal with water scarcity and food insecurity. According to Amoah and Jali's (2022) investigation, farmers use various coping mechanisms to ensure their households have enough food. While specific coping mechanisms may be helpful, others may negatively affect the population's overall health, particularly among children. In our study, adults would skip meals to protect their children from going to sleep without a meal.

Moreover, based on their study findings, Amoah and Jali (2022) recommended that small-scale farmers, and the local municipality should demonstrate active involvement in addressing climate change. The authors recommend that local municipalities should spend money on addressing issues related to droughts, heatwaves, floods, and soil erosion, such as prioritising dam construction to support rural farmers. They suggested that the dams can be a water reservoir, supporting irrigation activities during droughts.

Participants in our study were vocal about the need for more local and national government involvement. They felt that the government should at least supply the primary constraints, such as providing more boreholes in the community, as that could benefit the whole community. Boreholes may not be the best solution as it may drain the underground waterbed dry.

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Pili and Ncube (2022) reported that small-scale farmers use water from nearby sources, such as dams and rivers, to manage their agricultural operations. Respondents in this study mentioned that if they had the financial means, they would buy water tanks and build a dam for irrigation purposes.

Dlamini et al. (2023) reported that short-term coping mechanisms dealing with the prevention of food security included issues related to borrowing money, food or goods from family and friends or begging for food. In this study, respondents agreed that they borrow food or money from family, children, and friends. Alternatively, they would eat only simple and basic food, or sell livestock but participants' in our study did not support begging for food.

Another coping mechanism recommended is to implement mechanisms that could improve water conservation practices. This could include things using drip irrigation, and rainwater

harvesting, or developing drought-resistant crops, that involve breeding new varieties of crops that are more resistant to drought.

The allocation of funds for the development of irrigation infrastructure could facilitate the provision of water to farmers, even in periods of drought. Moreover, smallholder farmers should receive support, including access to credit, training, and markets. Educating the community about the importance of water conservation could also help them survive through drought periods, reduce water demand, and make water conservation more sustainable.

Furthermore, is it recommended that more research should be done to measure the the impact of water scarcity on different type of crops. This kind of research could help to identify the crops that are most vulnerable to water scarcity and develop strategies to mitigate their effects. An investigation into studying the connection between water scarcity and food security in different regions would help identify the area's most at risk of food insecurity due to water scarcity and targeted interventions can then be developed. By monitoring the impact of climate change on water scarcity and food security could help smallholder farmers track the progress of the problem and identify new challenges that need to be addressed.

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5.3 Conclusions from this primary research

Most of the rural households in Matatiele are moderately food secure. Water scarcity is a challenge for the households as they depend mostly on rainfall. They do not have sufficient plans to cope with floods and droughts and must sell live stock or borrow food or money to survive when they experience challenges with their crop production. Short-term coping strategies only cover survival and they do not have the means to implement adaptative strategies such as building dams. Buying water tanks or install irrigation systems on the smallholding would be highly recommended as a coping strategy. Other constraints that influence maize production is the lack of seeds, fertilisers destruction of crops by insects or pests. Poverty and food insecurity is an ongoing struggle for small-scale farmers in Matatiele.

5.4 Recommendations

The following recommendations are recommended.

- A needs assessment maybe valuable to determine the needs required to address the water scarcity experiences by the small-scale farmers to assist them to be self-sustainable to the point that they could sell some of their maize and other produce.
- Co-operation from the local government to assist with building of communal dams or provision or water tanks may assist in addressing the water scarcity.
- It is advisable that small-scale farmers should receive the same support as commercial farmers from the Government to help them to address issues like implementing appropriate water irrigation systems.
- It appears that the rainfall pattern is not consistent year on year, therefore may it assist farmers if they can receive long-term rainfall predictions to assist them when is the best time to plant.
- Small-scale farmers need education on long-term adaptative planning as they mostly concentrate on coping strategies to survive.

5.5 Chapter Five Summary

Chapter Five discussed some of the main outcomes of the study based on evidence in the field. The study demonstrates that small-scale farmers experience moderate food security, but water scarcity is a real problem that affects their livelihood; they only have short-term coping mechanisms, and the erratic rainfall has negative effects on their capability to produce maize and other agricultural crops.

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Annexures

Annexures

Annexure 1: Questionnaire

DROUGHT AND HOUSEHOLD FOOD SECURITY QUESTIONNAIRE

THE IMPACT OF WATER SCARCITY ON MAIZE PRODUCTION AT THE RURAL HOUSEHOLD LEVEL. THE CASE STUDY OF MATATIELE LOCAL MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA.

Please be aware that the survey is completely non-discriminatory and the information that you are about to give merely helps in the interpretation of the results. We want to assure you that by taking part in the survey your identity shall be kept in strict confidentiality. Also, your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you did agree to take part. There is no right or wrong answer to the questions. We just want to find out your honest opinion.

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SECTION A: DEMOGRAPHIC INFORMATION

Questionnaire number: _____

Data collector's Name: _____

Village: _____

Date: _____

A.1 Gender: Male [ ] Female [ ]

A.2 Age of the Respondent: _____

A.3 Education Level: _____

A.4 Farming Experience: _____

A.5 Full-Time or Part-Time: _____

A.6 Land Use Ownership

Communal [ ] Government [ ] Individual [ ] Cooperation [ ]

A.7 Land Use Scale (mark the correct answer)

0.5ha [ ] 1ha [ ] 2ha [ ] 3ha [ ] 4ha [ ]

A.8 Source of water for irrigation

Communal [ ] Government [ ] Individual [ ] Cooperation [ ]

SECTION B: HOUSEHOLDS FOOD SECURITY STATUS

Key: Yes (1) No (0) Not Applicable (2)

B.1 Number of households: ____

B.2 Is farming sole source of food?

Yes [ ] No [ ]

If no, what is other source of food? **Mark with X**

(a) Full-time employee [ ] (b) Part-time employee [ ] (c) Government parcels [ ] (d) other

B.3 What do you consider as the basic daily food requirement for your household in terms of produced crops?

_____
_____
_____

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B.4 Considering basic daily food requirement as minimum food intake required for living, do you think that the basic daily food intake of your household has improved in the last year?

Yes [ ] No [ ]

If yes, to what extent? **Mark with X**

(a) Slightly better [ ]

(b) Better [ ]

(c) Much better [ ]

If no, to what extent? **Mark with X**

(d) Same [ ]

(e) Worse [ ]

(f) Much worse [ ]

B.5 Did you and your household members ever skip a meal because there was not enough money to buy food over the last 12 months?

(a) Once a week [ ] (d) Once in 6 months [ ]

(b) Once a month [ ] (e) Never skipped the meal [ ]

(c) Once in 3 months [ ] (f) I don't know [ ]

B.6 Have any member of your family became sick because of lack of enough food in the past 12 months?

(a) Yes [ ]

(b) No [ ]

(c) Not applicable [ ]

B.7 Did you ever cut the size of children's meals due to insufficient food availability?

(a) Once a week [ ] (d) Once in 6 months [ ]

(b) Once a month [ ] (e) Never [ ]

(c) Once in 3 months [ ] (f) I don't know [ ]

B.8 Did any of the children ever not eat for a whole day because of lack of money to buy food?

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(a) Once a week [ ] (d) Once in 6 months [ ]

(b) Once a month [ ] (e) Never [ ]

(c) Once in 3 months [ ] (f) I don't know [ ]

B.9 Have you ever been very worried that you will run out of food in a particular year because of lack of money and agricultural produce in the past 20 years?

Yes [ ] No [ ]

If yes, what was the reason?

_____

_____

_____

_____

_____

B.10 How are you dealing with food shortages? **Mark with X where applicable**

(a) Borrowing from friends, neighbors or relatives [ ]

(b) Stick to simple food (e.g. veggies or spinach) [ ]

(c) Reduce expenditures on health [ ]

(d) Reduce expenditures on education [ ]

(e) Adults skip means once a day [ ]

(f) Selling assets (e.g. cycle, motorcycle, bull, farm equipment) [ ]

(g) Others (please specify):

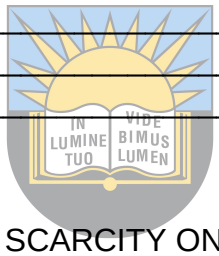
_____

B.11 Due to climate change and heavy flooding which affects crop production and leads to food price increases, how will you deal with the situation of food shortages, any planning?

Yes [ ] No [ ]

If yes, explain how:

_____
_____
_____
_____
_____



SECTION C: IMPACT OF WATER SCARCITY ON FARM PRODUCTION

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Mark with X where applicable

C.1 Animal farming

Types of animals:

_____
_____
_____
_____
_____

Type of farming system:

Free grazing [ ]

Cut-and-carry/ zero grazing [ ]

Improved pasture [ ]

Other (specify): _____

Crop farming

Types of crops:

_____
_____
_____
_____

Types of cropping systems:

Intercropping [ ]

Mono cropping [ ]

Rotation [ ]

Other (specify): _____

C.2 Are there any fertilizers that you apply on your crops?

Yes [ ] No [ ]

If yes, mention them:

_____
_____
_____
_____

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C.3 Illustrate the color of the soil where farming is taking place?

Black [ ] gray [ ]

Dark brown [ ]

Red Soil [ ]

C.4 What is the texture of the soil where farming is taking place?

Sandy soil [ ] Loam soil [ ]

Sandy-clay loam [ ]

Silt [ ]

Clay soil [ ]

C.5 Using the following scale: 1=poor 2=average 3=good 4=excellent

Sandy soil [ ] Loam soil [ ]

Sandy-clay loam [ ]

Silt [ ]

Clay soil [ ]

C.6 What is the slope of the farm? 0=steep 1=flat

Steep [ ] Flat [ ]

C.7 has drought negatively affected crop production over a 10 year period in your farm?

Yes [ ] No [ ]

If yes, in what extent has drought affected crop production?

0=severely [ ] 1=strong [ ] 2=average

C.8 In general, is there any observed positive differences in crop production over a period of 10 years?

Yes [ ] No [ ]

If yes, in what extent has crop production improved?

1=strong [ ] 2=average [ ] 3=excellent [ ]

C.9 Is water sufficient for crop growth and animal sustainability?

Yes [ ] No [ ]

If no, at what extent is water insufficient?

0=severely [ ] 1=strong [ ] 2=average [ ]

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C.10 How has water scarcity affected your household members in terms of food price increases due to reduced production levels?

0=severely [ ] 1=strongly [ ] 2= Average [ ] 3= Not at all [ ]

SECTION D: GENERAL QUESTIONS

D.1 Comment on the major constraints on the farming in the area (whether crops or animal production).

_____
_____
_____
_____

D.2 What inputs do you wish government could assist you with to sustain the production level? If there are any, please mention.

_____
_____
_____
_____

D.3 Are there any means of getting an income without selling own produced products? If there are any, please mention, explain. Yes [ ] No [ ]

_____
_____
_____
_____

D.4 Based on the current situation on agriculture, do you think in the next coming 10 years the farming would be improved or worse? Yes [ ] No [ ], Support your answer.

_____
_____
_____
_____

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Annexure 2: Ethical clearance

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ETHICS CLEARANCE
REC-270710-28-RALevel 01

Project Number: MAZ011SJIK01

Project title: The impact of water scarcity on maize production farming at the household level. The case study of the Matatiele Local Municipality, Eastern Cape, South Africa

Qualification: Master of Science: Environmental Sciences

Student name: Kholekile Jikwana

Registration number 201601876

University of Fort Hare
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Supervisor: Dr S. P Mazinyo

Department: Environmental Sciences

Co-supervisor: Dr S Ngarava

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby grant ethics approval for MAZ011SJIK01. This approval is valid for 12 months from the date of approval. Renewal of approval must be applied for BEFORE termination of this approval period. Renewal is subject to receipt of a satisfactory progress report. The approval covers the undertakings contained in the above- mentioned project and research instrument(s). The research may commence as from the 14/10/22, using the reference number indicated above.

Note that should any other instruments be required or amendments become necessary, these require separate authorisation.

Please note that UREC must be informed immediately of

● Any material changes in the conditions or undertakings mentioned in the document;

● Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The student must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

UREC retains the right to

● Withdraw or amend this approval if

o Any unethical principal or practices are revealed or suspected;

o Relevant information has been withheld or misrepresented;

o Regulatory changes of whatsoever nature so require;

o The conditions contained in the Certificate have not been adhered to.

● Request access to any information or data at any time during the course or after completion of the project.

Your compliance with Department of Health 2015 guidelines and any other applicable regulatory instruments and with UREC ethics requirements as contained in UREC policies and standard operating procedures is implied.

UREC wishes you well in your research.

Yours sincerely

2022.11.02

14:13:50

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+02'00'

Dr N Taole-Mjimba

Chairperson: University Research Ethics Committee

14 October 2022

Annexure 3: Informed consent

INFORMED CONSENT FORM

(Edit as Required)

I *(name of participant)*
……have been informed about the study by *(provide name of researcher/ project leader/ fieldworker)*
…….....

I understand the purpose, procedures, and risk-benefit ratio of the study.

I have been given opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any procedurals that I would usually be entitled to.

I understand that if I have any questions or complaints about my rights as a study participant, or if I may have concerns about any aspect of the study or the researcher/s then I may contact the Chairperson of the Inter-Faculty Research Ethics Committee, Dr A Nyika, or Chairperson of University Research Ethics Committee, Dr Taole-Mjimba (details available from the Researcher or by contacting the University of Fort Hare or Website www.ufh.ac.za)

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Participant signature: ……

Consenting for Audio Recording – when necessary

YES / OR

Participant signature: ……

Data curation – I understand that the information that I provide will be stored electronically and will be used for research purposes now or at a later stage *[to be altered according to the study]*

Participant signature: ……

Date: ……

Witness signature: ……...
[to be altered according to the study]

Translator signature: ……...
[to be altered according to the study]