

**FARMER'S PERCEPTIONS ON THE APPLICATION OF CLIMATE CHANGE
ADAPTATION STRATEGIES: A CASE STUDY OF SMALL-SCALE MAIZE
FARMERS IN WARD 27 OF THE GREATER GIYANI LOCAL MUNICIPALITY,
LIMPOPO, SOUTH AFRICA**

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DECLARATION

I hereby declare that the mini dissertation I am submitting to the University of Limpopo for the Master of Science in Agriculture (Agricultural Economics) has not been submitted by me for any degree at this or any other university. This work is solely my own, both in its design and execution, and I have appropriately acknowledged all sources and materials referenced within it.



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PUBLICATIONS

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DEDICATION

This mini dissertation work is dedicated to my grandmother, Khatisa Elinah Mkansi, and grandfather, Wilson Mkansi, for their prayers and support. I also thank my mother, Faith Busiswe Mkansi, for her belief in me, and my aunt, Marcia Mkansi, for her encouragement.

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ABSTRACT

The agricultural sector in South Africa plays an essential role in promoting rural development, reducing poverty, and ensuring food security. However, climate change poses a significant challenge to agriculture, impacting water availability, food supply stability, and overall ecosystem health. To address these concerns, adaptation strategies such as adjusting planting schedules and employing soil and water conservation practices are increasingly seen as vital for the long-term sustainability of farming operations. Although these strategies are well-documented globally, there is limited research on their implementation and perceived effectiveness among small-scale maize farmers in specific South African regions, such as ward 27 of the Greater Giyani Local Municipality in Limpopo Province.

The study's aim was to explore small-scale maize farmer's perception on the application of climate change adaptation strategies in ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa. The first objective of the study was to profile the socio-economic characteristics of small-scale maize farmers in Ward 27 of the Greater Giyani Local Municipality, Limpopo Province. The second objective was to evaluate the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area and the third objective was to determine factors influencing the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area. Data was collected from 130 small-scale maize farmers using snowball sampling technique.

Descriptive statistics results showed that the average age of the farmers was 57 years. Approximately 61% of the small-scale maize farmers in Ward 27 of Greater Giyani local Municipality were female and 39% were male. The study identified strategies used by small-scale maize farmers to enhance the risks of climate change. The most dominant strategy adopted was crop diversification (32.4%), followed by changing planting times (19.4%). Farmers also practiced efficient water management, including rainwater harvesting (12.6%) and improved irrigation methods (14.6%). Additionally, 10.7% used climate-resilient crop varieties. Other practices included adjusting plant spacing and pest control (3.2%) and applying mulching, composting, and organic manure (7.1%) to maintain soil fertility. The least-adopted strategy was other practices such as adjusting plant spacing and pest control.

To fulfil the second objective, a Likert scale along with descriptive statistics were employed to evaluate the perceptions of small-scale maize farmers regarding climate change adaptation strategies. Findings showed that about 55.1% of the farmers held positive views about the perceptions of the application of climate change adaptation strategies whereas 33.2% expressed negative perceptions. Additionally, 11.7% of the farmers were uncertain about the effectiveness or feasibility of implementing these adaptation strategies. Lastly, a Binary logistic regression model was applied to analyse the factors influencing small-scale maize farmers' perceptions of climate change adaptation strategies. The results from this model indicated that several variables significantly impacted these perceptions in Ward 27 of the Greater Giyani Local Municipality. Key factors included marital status, employment status, access to weather forecast information, and membership in farmers' cooperatives.

Based on empirical findings, it is suggested that the government enhance access to weather forecast information, improve employment opportunities for small-scale farmers, and strengthen access to farmer cooperatives to support climate resilience in agriculture. Improving the dissemination of accurate weather forecasts through local agricultural extension services and mobile technology can help farmers make informed decisions, thereby reducing vulnerability to climate variability. Additionally, launching targeted programs for employment in climate-resilient agricultural strategies and providing training in sustainable techniques can promote job creation and investment in adaptation strategies. Finally, encouraging the formation of agricultural cooperatives can facilitate collective bargaining and resource sharing, enabling farmers to adopt climate-smart practices more effectively. These recommendations are consistent with national strategies designed to improve food security, alleviate poverty, and promote sustainable livelihoods in response to climate change.

Keywords: Climate change, Perception, Adaptation strategies, Small-scale maize farmers

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
WB	World Bank
SA	South Africa
USA	United State of America
IPCC	International Panel on Climate Change
CCKP	Climate Change Knowledge Portal
NDA	National Development Agency
GSA	Government of South Africa
ERIT	Environmental Resilience Institute
UNFCCC	United Nations Framework Convention on Climate Change
GHG	Greenhouse Gas
EPA	Environmental Protection
CO ₂	Carbon Dioxide
OECD	Organisation for Economic Co-operation & Development
AfDB	African Development Bank Group
USAID	United States Agency for International Development
CSIR	Council for Scientific & Industrial Research
DALRRD	Department: Agriculture, Land Reform, & Rural Development
IDP	Integrated Development Plan
FAO	Food & Agriculture Organisation
SSA	Sub-Saharan Africa
VIF	Variance Inflation Factor
SPSS	Statistical Package for Social Sciences
Stats SA	Statistical South Africa
NCCAS	National Climate Change Adaptation Strategy
NDP	National Development Plan
NPC	National Planning Commission

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Agriculture serves as one of the economic foundations for many developing nations and plays a crucial role in contributing to their gross domestic product (GDP). A significant portion of the impoverished population, especially small-scale farmers in the least developed countries, resides in rural areas and relies on agriculture for their livelihoods (Astrat and Babiso, 2020). The advancement of agriculture holds the potential to eliminate poverty and sustainably feed around 10 billion individuals by the year 2050 (World Bank, 2024). The growth in the agricultural sector is significantly more efficient, enhancing incomes among the poorest segments of society by two to four times compared to other sectors (World Bank, 2024). Additionally, the agricultural industry in Africa plays a significant role both socially and economically as it offers jobs to approximately two thirds of the continent's workforce and contributes an average of 30% to 60% of each country's GDP, along with 30% of export value (Gardiner *et al.* 2024). In Sub-Saharan Africa, approximately 60% of the population is involved in agriculture, and the GDP contribution is about 16.9%, this percentage is for agriculture, forestry and fishing. Smallholder farmers are a significant part of this agricultural sector (World Bank, 2023 and Goedde *et al.* 2019).

Woetzel *et al.* (2020) argued that climate change poses increased difficulties for agricultural advancement in Africa due to the deteriorating weather, leading to heightened unpredictability in crop and livestock yields. Similarly, the frequency and severity of extreme events are escalating due to projected temperature increases, while shifts in rainfall patterns are anticipated to intensify beyond current levels (Woetzel *et al.* 2020). The adverse effects of these alterations are anticipated to affect individuals engaged in agriculture, given that agriculture heavily relies on climate-sensitive factors like temperature, precipitation, and soil fertility (Thinda *et al.* 2020).

The unpredictability in agricultural production is significantly heightened by climate change, manifesting in increased occurrences of floods, droughts, temperature extremes, and soil degradation (Akandi *et al.* 2021). Regions, which are heavily reliant on rainfed food production as their primary source of staple food, are confronted by

severe consequences of these changes (Ndlhve *et al.* 2017). This increased vulnerability not only jeopardizes crop yields but also poses a critical threat to overall food security. Considering these challenges, there is a pressing need for proactive measures and adaptive strategies to mitigate the impacts of climate change on agricultural systems and enhance resilience in food production.

South Africa, recognized as a water-scarce country (Nhamo *et al.* 2020), is increasingly vulnerable to the effects of climate change due to its semi-arid climate. The country's heavy reliance on rainfed agriculture exacerbates this vulnerability, as highlighted by Dabrowski *et al.* (2008) and Ndhleve *et al.* (2017). The agricultural sector plays a vital role in South Africa, providing over 70% of the food, employment, and livelihoods in the southern African region (Cammarano *et al.* 2020). However, farmers face numerous challenges, including limited access to arable land, rising production costs, insufficient technological support, and poorly implemented policy measures (Mapfumo *et al.* 2014). These constraints make it difficult for farmers to effectively address climatic challenges. The complex interaction of these factors emphasizes the need for comprehensive and targeted strategies to enhance the resilience of South Africa's agricultural systems in light of changing climatic conditions.

In South Africa, maize was initially brought into cultivation in 1655, marking the inception of its prominence as a primary food crop. Its cultivation spans across all provinces of the country, with notable emphasis on production in regions like the Free State, Gauteng, Mpumalanga, and the North-West. Annually, the nation dedicates an average of 2.5 to 2.8 million hectares of land for commercial maize farming endeavours (Sihlobo, 2018).

Maize (*Zea mays*) is the predominant crop in South Africa's grain production, contributing to 83% of the total output (Diko and Wang, 2020). It is a crucial dietary staple for millions, especially in developing nations, where it plays a vital role in food security and provides essential calories, protein, and nutrients to a large portion of the population (Ryan, 2023). During the 2021/22 season, South Africa was the ninth-largest maize producer globally and the leading producer on the African continent, with an annual output of approximately 14 million tonnes comprising about 12 million tonnes of white maize and 2 million tonnes of yellow maize (Adama, 2023).

Due to a heavy dependence on rainfed agriculture (van Niekerk *et al.* 2018), maize production in South Africa faces significant threats from extreme weather occurrences like heatwaves, droughts, and floods. The global maize production experienced a high devastation of droughts in 1992 and 2015/16, prompting substantial humanitarian aid efforts (Callihan and Eriksen, 1994; Rembold *et al.* 2016). In 2022, flooding resulted in the destruction of 60% of the planted maize in South Africa (Coleman, 2022). The limited availability of technology and agrochemicals further exacerbates the situation, resulting in comparatively lower maize yields than in countries like the United State of America and Argentina, consequently the food system becomes increasingly vulnerable to the impacts of extreme climate events (Bradshaw *et al.* 2022).

Given the falling maize production patterns attributable to climate-related causes, there is a rising understanding of the need for adaptation measures (Akanbi *et al.* 2021). Responding to climate change involves farmers implementing diverse adaptation measures to mitigate its adverse effects on agricultural activities. These measures include, crop diversification, adoption of drought-resistant maize varieties, water management, and improved irrigation practices (Fadina *et al.* 2018). Such proactive approaches are associated with enhanced agricultural productivity and improved livelihoods. Additionally, adapting to climate change plays a significant role in enhancing household food security and overall welfare among farming communities (Kogo *et al.* 2021). The Intergovernmental Panel on Climate Change (IPCC) (2014) warns that while adaptation efforts can alleviate the effects of climate change, their efficacy is limited by the escalating frequency and intensity of climatic shifts. Adaptation strategies ought to be forward-thinking, flexible, feasible, and regularly reviewed to ensure they offer sufficient resilience for sustainable crop production, food security, and livelihoods (Akanbi *et al.* 2021).

This research project delved into the perceptions of small-scale maize farmers in ward 27 of the Greater Giyani Municipality concerning the application of climate change adaptation strategies. By evaluating farmers' perceptions on the application of climate change adaptation strategies, as well as identifying the socio-economic factors influencing their perceptions, the research seeks to assess the effectiveness of existing adaptation strategies and highlight the challenges hindering their implementation. By grasping and addressing farmers' perspectives, tailored and

effective interventions could be crafted to support their adaptation endeavours and ensure the enduring sustainability of agriculture amidst climate change challenges.

1.2 Problem Statement

The global consequences and implications of climate change have emerged as a pressing concern (Poushter *et al.* 2019). The rapid pace of climate change and rising temperatures have escalated dramatically, surpassing historical trends and creating unprecedented challenges for ecosystems, human societies, and global stability (Climate Change Knowledge Portal (CCKP), 2021). This disruption to the natural order carries significant consequences for humanity, other living organisms, and agricultural practices. Numerous studies indicate that many farmers in sub-Saharan Africa depend on rain-fed agriculture for their livelihoods (Moyo *et al.* 2012; Shiferwa *et al.* 2014; Kihupi *et al.* 2015).

Small-scale maize farmers are frequently affected by erratic weather conditions and climate fluctuations, particularly in terms of temperature and precipitation. Historical trends indicate that Southern Africa is likely to face rising temperatures, decreasing rainfall, and an increase in extreme weather events, including droughts and floods, in the coming years (Moyo *et al.* 2012). This anticipated situation highlights the critical need to tackle the effects of climate change. Limpopo Province is especially vulnerable, having been identified as a major hotspot for climate change (National Development Agency in 2014).

One of the most significant impacts of climate change is the reduction in agricultural productivity, which leads to decreased food supply, increased food insecurity, and heightened poverty levels (Wheeler *et al.* 2013). Small-scale maize farmers in Limpopo Province are particularly at risk due to their dependence on rain-fed agriculture, which is highly susceptible to climate variability (Government of South Africa, 2011). Although various climate change adaptation strategies exist, such as crop diversification, using drought-resistant seeds, optimizing planting schedules, managing water resources, and improving irrigation techniques, their widespread implementation among small-scale maize farmers in rural areas of Limpopo is often hindered by several obstacles. Challenges such as limited access to credit,

inadequate information, and insufficient extension services frequently restrict farmers' ability to effectively adopt these strategies (Gbetibouo *et al.* 2010; Nkoana *et al.*, 2021).

Numerous studies have been conducted on various aspects of climate change, including assessments of drought risk (Mpandeli *et al.* 2013), the impact of climate variability on agricultural output (Olwoch *et al.* 2013), the adaptation strategies employed by farmers (Debela *et al.* 2015), and the factors influencing their choice of coping mechanisms (Maponya and Mpandeli, 2013). However, there is a lack of research regarding the perceptions of small-scale maize farmers concerning the implementation of climate change adaptation strategies. Consequently, this study aims to explore how small-scale maize farmers in Ward 27 of the Greater Giyani Local Municipality perceive these adaptation strategies and to identify any challenges that may hinder their effective implementation.

1.3 Motivation of the study

Agriculture is essential for ensuring food security on farms and supporting the livelihoods of small-scale maize farmers. The sustainability of these farmers' livelihoods largely depends on the income generated from maize cultivation (Mbatha *et al.* 2021). However, this sector is particularly susceptible to the adverse effects of climate change, which threaten production levels, food security, and overall income. The Intergovernmental Panel on Climate Change (IPCC) (2013) highlights that climate change negatively impacts freshwater resources, agricultural productivity, human survival, and quality of life. Consequently, addressing climate change is vital not only for environmental sustainability but also for enhancing the well-being and resilience of communities around the globe.

Climate change negatively impacts crop yields, particularly for vulnerable populations in rural areas, such as small-scale maize farmers who depend on rain-fed agriculture (Turpie and Visser, 2015). Despite these challenges, maize production is essential for rural households, providing food security and income (Lahiff, 1997; Lwandiso *et al.* 2021). The benefits derived from maize cultivation help farmers sustain their livelihoods and manage food scarcity. However, the ongoing effects of climate change threaten the long-term viability of crop production, ultimately jeopardizing the ability of rural households to maintain their livelihoods.

Numerous studies have investigated the technical viability and effectiveness of various adaptation strategies, including crop diversification, soil and water conservation techniques, and enhanced irrigation practices, in relation to the impacts of climate change on small-scale farmers in South Africa (Maponya and Mpandeli, 2013; Turpie and Visser, 2013; Ziervogel *et al.*,2014). However, there is still a significant gap in understanding how farmers perceive and implement these strategies in response to climate change. Gaining insight into farmers' views on these adaptation methods is essential, as it can significantly affect their willingness to adopt and apply them. Furthermore, by understanding and addressing farmers' perspectives on climate change adaptation strategies, targeted interventions can be developed to support their adaptation efforts and ensure the long-term sustainability of agriculture in the face of changing climatic conditions.

1.4 Scope of the study

1.4.1 Aim of the study

This study aimed to explore small-scale maize farmer's perception on the application of climate change adaptation strategies in ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa.

1.4.2 Objectives of the study were:

- i) To profile the socio-economic characteristics of small-scale maize farmers in ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa.
- ii) To evaluate the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area.
- iii) To determine factors influencing the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area.

1.4.3 Hypotheses of the study were:

- i) The small-scale maize farmers have a negative perception towards the application of climate smart approaches in ward 27 of the Greater Giyani Local Municipality, Limpopo Province , South Africa.

- ii) Factors such as age, gender, marital status and other socio-economic characteristics do not influence the perception of small-scale maize farmers on the application of climate change adaptation strategies in the study area.

1.5 Organisation of the study

The study is organized in a systematic way. The first chapter introduces the research by outlining the problem and the motivation behind it, as well as presenting the research aims, objectives, and hypotheses that guide the investigation. The second chapter reviews the existing literature on relevant empirical studies related to farmers' perceptions, climate change, adaptation strategies, and maize production. Chapter 3 describes the study area, details the research methodology used, and outlines the various analytical techniques employed to meet the study's objectives. In Chapter 4, the findings are presented and discussed in relation to the stated objectives. Finally, Chapter 5 concludes with a summary of the findings, offers conclusions, and provides recommendations based on the results.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides a literature review pertinent to the study. It begins by defining essential concepts and subsequently examines prior research conducted both locally and internationally. This structure aids in clarifying the key terms related to the topic and offers valuable insights into previous studies, ultimately allowing for the identification of gaps, findings, and recommendations highlighted in those studies.

2.2 Definition of key concepts

2.2.1 Perception

Perception, according to Kannan *et al.* (2022), is the process by which individuals receive information or stimuli from their surroundings and transform it into psychological awareness to construct meaningful experiences, whereas Thiruvengkataj *et al.* (2017) defined perception as a process by which individuals organise and interpret their sensory impressions in order to give meaning to their environment. Therefore, in this study the farmers perception refers to the understanding that the farmers have regarding the implementation and effectiveness of climate change adaptation strategies.

2.2.2 Climate Change

Climate change is commonly described as a notable alteration in average weather patterns over an extended period, such as conditions becoming warmer, wetter, or drier. Unlike natural weather fluctuations, climate change is characterized by its long term trend (World Bank, 2024). The Intergovernmental Panel on Climate Change (IPCC) has proposed a considerably broader definition of climate change, claiming that climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (IPCC 2014). Droughts and floods are key indicators of climate variation, leading to the destruction of vegetation and soil depletion. Over recent years, drought occurrences have increased, diminishing soil moisture levels and available water for plants/crops, leading to significant water scarcity (IPPC, 2014). This decline in soil moisture not only impacts irrigation resources but also hampers the growth of non-irrigated vegetation.

2.2.3 Adaptation Strategies

Adaptation strategies encompass programs, projects, or approaches designed to address expected climate change impacts in particular areas of potential concern (Environmental Resilience Institute (ERIT), 2017). Therefore, in this study the adaptation strategies involve crop diversification, water management, soil conservation, use climate-resilient crop varieties, change planting time, improved irrigation practices, invest in water conservation techniques such as drip irrigation and rainwater harvesting, and adjust farming practices. Adaptation is defined as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007; UNFCCC, 2010). This definition encompasses financial, socio-economic, and institutional adjustments. Consequently, climate change adaptation involves a range of activities that populations undertake to respond to various pressures resulting from a changing climate (Nyong *et al.*, 2007; Menike and Arachchi, 2016). These responses or adjustments can be environmental, social, or economic at a system level (IPCC, 2014; Komba and Muchapondwa, 2015). Therefore, climate change adaptation is seen as the process through which individuals and communities modify their customary ways of life and activities to cope with the impacts of climate change (Komba and Muchapondwa, 2015; Makuvaro *et al.* 2018). In the context of small-scale maize farmers in Ward 27 of the Greater Giyani Local Municipality, Limpopo, South Africa, climate change adaptation involves implementing strategies to mitigate the impacts of climate variability on maize production.

2.3 Review of previous studies

2.3.1 Climate change: A global view

The significant global changes witnessed and expected in climatic patterns throughout the twenty-first century, including global warming, have been notable over the past 65 years (Abbass *et al.* 2022). Climate change poses a global hazard to humanity (Tau, 2023). Greenhouse gas (GHG) emissions are one of the root causes of this worldwide problem (Nema *et al.* 2012). The primary greenhouse gases include carbon dioxide, methane, nitrous oxides, and fluorinated gases (Environmental Protection Agency-EPA, 2017). Climate change presents a multifaceted challenge at the global level, influencing various aspects of ecological, environmental, socio-political, and socio-economic domains (Leal Filho *et al.*, 2021; Feliciano *et al.*, 2022). The agricultural

sector on a global scale is accountable for 30–40% of total greenhouse gas emissions, positioning it as a primary contributor to climate change and subject to substantial impacts from it (Thornton and Lipper, 2014; Andersen, 2021; Mishra *et al.*, 2021; Ortiz *et al.*, 2021).

Various agro-environmental and climatic elements, as highlighted by Pautasso *et al.* (2012), exert a significant influence on agricultural productivity. The interconnection between agriculture and climate change involves a complex cause-and-effect dynamic. Agriculture contributes to greenhouse gas emissions into the atmosphere, while simultaneously being susceptible to the impacts of climate change (Wreford *et al.*, 2017). Global climate change has caused rising temperatures over the last century, prompting occurrences such as droughts, heat waves, higher precipitation levels, storms, and flood hazards. Moreover, significant amounts of carbon dioxide (CO₂) have been released into the atmosphere (Nema *et al.* 2012; OECD, 2016).

Furthermore, the world's agriculture is becoming more vulnerable to destruction due to the extreme reliance on finite resources (Godfray *et al.* 2010). The reduction in agricultural productivity poses a significant threat to farmers' quality of life, which in turn plays a significant role in poverty because climate change has a vital impact on food and water supplies (Rosenthal *et al.* 2014; Ortiz *et al.* 2021).

In rural Bangladesh, households vulnerable to hazards have acknowledged the influence of climate change on their means of living and have embraced a variety of approaches (both agricultural and non-agricultural), to cope with the challenges. These approaches varied notably among different farming communities. Notable strategies encompassed the utilization of novel crop varieties, altering planting schedules, and engaging in migration (Alam *et al.* 2017). Meanwhile, in Nepal, Khanal *et al.* (2018) determined that the adoption of suitable adaptation measures has remarkably enhanced food productivity. Their research revealed that strategies such as effective soil and water management exerted the most significant impact on food output, followed by the timing of agricultural activities and adjustments in crop varieties (Khanal *et al.* 2018).

In Iran, the implementation of new, late-maturing crop varieties, enhanced irrigation practices, a modest rise in fertilizer usage, adjustments in planting schedules, and the introduction of heat-resistant strains have demonstrated a favourable effect on maize

production in the cooler regions of the country (Rezaei and Lashkari, 2019). Similarly, in China, three adaptation strategies like altering planting dates, transitioning to later maturing crop varieties with extended growth periods, and developing strains with elevated thermal tolerance - were observed to enhance maize yield to varying extents (Lin *et al.* 2017). Among these strategies, the research concluded that transitioning to later maturing cultivars proved most effective in mitigating the adverse effects of a warming climate (Lin *et al.* 2017).

2.3.2 Climate change: African overview

The United Nations Framework Convention on Climate Change (UNFCCC) (2007) indicates that the increased use of fossil fuels and changes in land use have led to higher levels of greenhouse gas emissions. This rise in greenhouse gases has intensified the Earth's greenhouse effect, contributing to climate change. As a result, elevated greenhouse gas concentrations have increased the retention of solar heat. Climate change significantly affects various environmental and societal aspects, including environmental degradation, socio-economic issues, agriculture, water resources, food security, and public health (UNFCCC, 2007; UNFCCC, 2020).

Although Africa boasts the lowest per capita greenhouse gas emissions globally, it remains profoundly affected by the repercussions of climate change. The continent's most impoverished communities frequently find themselves vulnerable to severe weather occurrences like droughts and floods, leaving them defenceless. The ensuing famine and livelihood insecurity often result in catastrophic consequences. (Fearnhead, 2022). Africa is also vulnerable to several climate-sensitive diseases including Tuberculosis, Diarrhea and Malaria (Owens *et al.* 2011). The African Development Bank Group (2024) states that Africa is the continent most at risk from the effects of climate change if global temperatures exceed a growth rate of 1.5 degrees Celsius.

Despite being the smallest contributor to global warming and producing minimal emissions, Africa faces swift and severe consequences that pose systemic risks to its economies, infrastructure, water and food systems, public health, agriculture, and livelihoods. These impacts threaten to reverse the continent's limited progress in development and could lead to heightened levels of extreme poverty (African Development Bank Group, 2024).

Africa's vulnerability to climate change is intensified by multiple factors. Sub-Saharan Africa is particularly dependent on rain-fed agriculture, which represents 95% of such farming practices worldwide (Nkatha, 2024). This reliance, combined with agriculture's vital role in regional GDP and employment, increases susceptibility to climate impacts. Additionally, climate-sensitive livelihoods such as herding and fishing further elevate risks, leading to income reductions and greater food insecurity. This vulnerability is reflected in the fact that seven of the ten countries most at risk from climate change are in Africa. In 2015, four African nations: Mozambique, Malawi, Ghana, and Madagascar, were ranked among the top ten most affected countries, highlighting the continent's pressing challenges in addressing climate impacts (African Development Bank Group, 2024).

Fosu-Mensah *et al.* (2012) conducted research aimed at understanding the perceptions of farmers in the Sekyedumase district of Ghana's Ashanti region regarding climate change and analyzing their responses to adaptation. The study utilized a logistic regression model to identify the key factors influencing farmers' perceptions and adaptation strategies, which included access to extension services, availability of credit, soil fertility, and land tenure. Significant barriers identified in the research were a lack of information about adaptation strategies, poverty, and insufficient weather-related data. In a related study, Miller *et al.* (2020) found that many developing countries in Africa have experienced an increase in extreme weather events such as floods, droughts, heatwaves, and tropical cyclones. These events have intensified beyond previous levels, leading to considerable negative effects on the environment, agricultural productivity, and the livelihoods of individuals due to ongoing climate variability and change.

2.3.3 Climate Change: South African overview

Climate change is having a profound impact on South Africa's ecosystems, economies, and communities (USAID, 2023). Since 1990, the country's average temperature has increased at a rate that is twice the global average. The National Adaptation Plan of South Africa (2021) highlights a rise in extreme weather events, including more frequent heat waves, longer dry spells, and increased rainfall intensity. Water security is particularly affected, with droughts and water shortages becoming more common in various regions. Additionally, the anticipated changes in temperature extremes are expected to place additional strain on the healthcare system by

increasing the prevalence of diseases and affecting critical areas such as infrastructure, medical supply availability, and emergency services (USAID, 2023). Southern Africa is projected to experience rapid increases in annual average near-surface temperatures throughout the twenty-first century, with temperatures in South Africa's interior expected to rise at a rate 1.5 to 2 times faster than the global average (Council for Scientific and Industrial Research (CSIR), 2019).

South Africa is characterized predominantly as a semi-arid region, and it experiences an average annual rainfall of approximately 450 mm/year (Botai *et al.* 2018). The country's climate exhibits considerable diversity due to its varied topography, ranging from arid and semi-arid conditions in the dry northwest to more humid conditions along the eastern and coastal regions (Dinar *et al.* 2012). Facing water stress, South Africa contends with significant temporal and spatial fluctuations in water availability. The pronounced variability in rainfall across the country renders it susceptible to extreme climatic events, impacting sectors such as agriculture, water resources, and the broader economy (Phakula *et al.* 2018).

Climate change can significantly impact agricultural production (Matimolane *et al.* 2022). Some research suggests that climate change is widely regarded as a reality (Stocker *et al.* 2013; Zhang *et al.*, 2015). The IPCC (2013) found that increasing annual rainfall variance will lead to more severe and frequent droughts and floods. Climate change leads to water scarcity, which limits crop output. Water availability is crucial for maize growth in rainfall-dependent regions (Moeletsi and Walker, 2012). Climate change poses threats to various economic sectors in South Africa, with Ubisi *et al.* (2017) identifying vulnerable sectors such as natural resources, agricultural forestry, tourism, manufacturing, and health. South Africa's severe poverty and inequality makes climate change a significant challenge for national development (Tau, 2023).

Gbetibouo *et al.* (2010) conducted a study revealing that the impact of climate change and variability doesn't consistently coincide with regions exhibiting high sensitivity or low adaptability. Moreover, they underscored the intrinsic link between climate change vulnerability and variability with socio-economic development. The research specifically pinpointed the Western Cape and Gauteng provinces as having advanced infrastructure, high literacy rates, and a low contribution of agriculture to the overall GDP, rendering them less vulnerable. Conversely, the study identified Limpopo,

KwaZulu-Natal, and the Eastern Cape as highly vulnerable regions characterized by sparsely populated areas, a prevalence of small-scale farming, reliance on rain-fed agriculture, and significant land degradation.

In South Africa, temperatures are on the rise at a rate of roughly 0.2°C per decade, contributing to a spectrum of climate impacts, from severe heatwaves and droughts to rising sea levels and increased flooding (Asadnabizadeh, 2022). The Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC), issued in 2021, highlights that the surge in greenhouse gas emissions due to human activity has amplified both the frequency and severity of extreme weather occurrences. Across South Africa, average rainfall has diminished in all regions except the north-west, as noted in the same report. The IPCC report underscores that human-induced climate shifts heightened the deficit in rainfall, exacerbating the severe drought experienced from 2015 to 2017, making it three to six times more likely to occur.

Despite an overarching trend towards drier conditions, there has been a noticeable uptick in the intensity and frequency of heavy rainfall events. Climate change has also doubled the probability of extreme rainfall, evidenced by the intense deluge experienced in certain parts of South Africa in April 2022, resulting in the tragic loss of 400 lives and displacing thousands from their homes (Johnston, 2024). In South Africa's surrounding oceans, there has been a discernible escalation in marine heatwaves, alongside a steady rise in sea levels. Between 1900 and 2018, sea levels in the South Atlantic Ocean increased by 2.07 mm annually, while in the Indian Ocean, the rise was recorded at 1.33 mm per year (Johnston *et al.* 2024).

2.3.4 Climate change and maize production in South Africa

According to the Department of Agriculture, Forestry and Fisheries (DAFF) (2022), maize is the dominant staple food and the most widely grown field crop in South Africa, followed by crops like soya beans, wheat, sunflower, groundnuts, grain sorghum, and other legumes. Maize production, both white and yellow, is concentrated in areas with summer rainfall. Annual local production varies, with yellow maize output ranging from 4.37 million to 7.7 million tons, and white maize from 7.7 million to 16.8 million tons. Notably, the highest production levels were recorded in 2021 for yellow maize, at 7.72 million tons, and in 2017 for white maize, at 18.82 million tons, marking the highest

yields over the past decade. On average, yield levels fluctuate between 5.33 to 7.25 tons per hectare for white maize and 4.00 to 6.40 tons per hectare for yellow maize.

Baloyi's study (2011) and the DAFF (2021) emphasized maize production as widespread across South Africa. The provinces of Free State, Mpumalanga, and Northwest emerged as the primary contributors accounting for approximately 84% of total production and collectively responsible for over four-fifths of the nation's maize output. Maize is primarily grown on dry land, with irrigation accounting for less than 10% of total production. It plays a crucial role in the agricultural sector, serving as a staple food for humans, fodder for livestock, and an essential raw material for various industries. While most maize cultivation occurs on dry land, only a small percentage utilizes irrigation systems (Baloyi, 2011).

Several studies have been carried out in South Africa to assess the impact of climate variability on maize farming. For instance, Mangani *et al.* (2019) conducted research aimed at modelling the effects of climate change and quantifying maize yield responses in the Highveld region. They utilized six general circulation models and examined three time periods: the baseline (1990–2020), the near future (2021–2050), and the far future (2051–2080). Their simulations focused on the effects of extreme heat and drought on maize production, using climate data based on two different radiative forcing scenarios. Projections indicated a notable decline in maize yields, particularly during the far future period. Across various locations in the Highveld, a simulated reduction in maize yield ranging between 18% and 30% was forecasted (Mangani *et al.* 2019).

Additionally, Oduniyi *et al.* (2019) found that climate change has markedly decreased maize production in South Africa. This decline is anticipated to adversely affect the maize economy and alter the regions where maize is cultivated in the country. These studies underscore the necessity of creating effective adaptation strategies for maize farmers, especially in South Africa's primary production regions. The findings also stress the importance for maize producers in South Africa to adapt to climate change in ways that will ensure sustainable maize production both now and in the future.

2.3.5 Small-scale maize farmers' perceptions of climate change

The perceptions of small-scale maize farmers regarding climate change are vital for addressing its effects on maize production (Tau, 2023). Farmers are particularly

vulnerable to climate change due to their dependence on climate-sensitive factors. Therefore, understanding how farmers perceive climate change is essential for analyzing their adaptive behaviors (Wang *et al.* 2014). A study by Olabanji *et al.* (2021), titled "Assessment of Smallholder Farmers' Perception and Adaptation Response to Climate Change in the Olifants Catchment, South Africa," explored this topic. The results showed that 98% of respondents recognized changes in local climate, especially concerning temperature and rainfall fluctuations. The study also identified significant obstacles to adopting adaptation strategies, such as limited access to credit, markets, irrigation, information on climate change, and extension services (Olabanji *et al.* 2021).

A study by Ibrahim *et al.* (2019) examined farmers' preferences for seasonal climate forecasts and their willingness to invest in such information. The findings revealed that a significant majority of small-scale maize farmers (85.33%) recognized changes in the climate, while a smaller percentage (14.67%) did not perceive any alterations in climatic conditions (Ibrahim *et al.* 2019). Among those who acknowledged climate change, various adaptation strategies were implemented: early planting (10%), adjusting planting dates (40%), using short-duration crop varieties (15%), creating firebreaks around farms (5%), adopting improved seed varieties (20%), and applying fertilizers (10%) (Ibrahim *et al.* 2019). In a separate study, Baudoin *et al.* (2014) found that none of the participants, regardless of their educational levels, were familiar with the term "climate change," although all observed changes in seasonal rainfall patterns. This underscores the importance of farmers' awareness of climate change for effectively implementing adaptation strategies.

2.3.6 Determinants of Climate Change Adaptation Strategies

Climate is a key factor in agricultural productivity, influencing crop yield both directly and indirectly through its effect on physiological processes (Adeagbo *et al.* 2021). Understanding the strategies farmers use to reduce the negative impacts of climate change is therefore essential. It is also critical to investigate the factors influencing smallholder maize farmers' adoption and the extent to which they implement climate adaptation practices (Adeagbo *et al.* 2021). Research shows that small-scale farmers generally have limited awareness of climate change, both in terms of perception and adaptation (Guo *et al.* 2021). Arbuckle *et al.* (2013) argue that small-scale farmers' perceptions of climate change may not fully align with actual climate trends, potentially

leading to ineffective adaptation measures. According to Frank *et al.* (2011), farmers must first recognize the effects of climate change before they can choose appropriate responses. Various factors shape small-scale farmers' attitudes and behaviors toward climate adaptation, including farming experience, income levels, access to climate-related information, and educational background (Kumar *et al.* 2023). Additional influences include gender, age, cognitive perceptions of temperature or rainfall shifts, and socioeconomic aspects like access to networks and markets (Guo *et al.* 2021).

Adaptation and mitigation are crucial for reducing the negative impacts of climate change. Adaptation strategies play a key role in directly lowering the vulnerability of small-scale farmers, while mitigation efforts aim to slow down the rate and extent of climate change (Ntanos *et al.* 2018a; Abid *et al.* 2019). A study by Ogundeji (2022) found that small-scale farmers commonly implement various adaptation strategies to shield themselves from the effects of climate change. These strategies include improving crop varieties to include early maturing and drought-resistant options, adjusting planting dates, practicing soil and water conservation, utilizing organic fertilizers, applying mulch, and diversifying crops.

2.4. Chapter summary

This chapter explored the literature on climate change and its impacts, particularly focusing on farmers' perceptions and adaptation strategies. Perception is the process by which individuals interpret their environment, crucial for understanding farmers' views on climate adaptation. Climate change is characterized by long-term alterations in weather patterns due to human activities, leading to phenomena like droughts and floods. Adaptation strategies involve various programs and measures to mitigate climate impacts, including crop diversification and water management.

Globally, climate change poses significant challenges, driven by greenhouse gas emissions, impacting agriculture and necessitating adaptive measures. Studies in regions like Bangladesh, Nepal, and Iran show the effectiveness of strategies such as altering planting dates and using heat-resistant crops. In Africa, despite low emissions, the continent faces severe climate impacts, with adaptation hindered by socio-economic challenges. South Africa, with increasing temperatures and variable rainfall, experiences significant agricultural impacts, particularly on maize production, which is a staple crop. Effective adaptation strategies are crucial to maintaining productivity.

Research highlights that while many farmers are aware of climate changes, barriers like limited access to credit and information hinder their adaptation efforts. Factors influencing adaptation include farming experience, income, and education. Common adaptation strategies involve using drought-tolerant crops, adjusting planting dates, and implementing soil conservation techniques. Comprehending these dynamics is crucial for formulating effective climate adaptation policies that can assist at-risk farming communities.

CHAPTER THREE: RESEARCH METHODOLOGY AND ANALYTICAL PROCEDURES

3.1 Introduction

This chapter provides an overview of the study area and details the methodology used to achieve the study's objectives. It discusses the data sources, the sampling methods used to gather primary data, and the techniques for data analysis.

3.2 Study area

The research was carried out in Ward 27 of the Greater Giyani Local Municipality, which is classified as a Category B municipality within the Mopani District of Limpopo Province, South Africa. Established under the 1996 Constitution of the Republic of South Africa and the Municipality Demarcation Act of 1998, the Greater Giyani Municipality is one of five municipalities in the Mopani District. It spans an area of approximately 2,967.27 km² and has a population of 256,300 individuals living in 70,537 households (Integrated Development Plan (IDP) 2020/21). Giyani, founded in 1969 and often referred to as the "place where people dance" and "land of the friendly people," serves as the administrative and commercial hub of the Mopani District. Located about 185 km from Polokwane, 100 km from Thohoyandou, and 550 km from Pretoria, its eastern section borders the Kruger National Park.

The Greater Giyani Local Municipality comprises 31 wards and 10 traditional authorities with 91 villages. Its main economic sectors are agriculture, tourism, retail, and transport. Ward 27 was chosen for the study to focus on the specific experiences and challenges faced by small-scale maize farmers. This ward-specific research allowed for a detailed understanding of the local variations in climate, geography, and socio-economic factors, contributing valuable insights into the resilience and adaptability of these farmers. Maize is an important staple crop in ward 27 of the Greater Giyani Local Municipality, providing both food security and cash income for small-scale farmers.

The reliance on maize as a primary source of sustenance makes it a vital part of the livelihoods of many households in the area. However, maize production in this area is extremely vulnerable to climate change, posing significant challenges for small-scale

farmers. The climatic conditions in ward 27 are characterized by high temperatures and recurrent droughts, which directly affect maize yields. The optimal temperature range for maize growth is identified as 18°C to 32°C, with temperatures exceeding 35°C being detrimental to its development (Akanbi *et al.* 2021). Research indicates that prolonged exposure to temperatures above 30°C can significantly reduce maize yields due to heat stress, particularly during critical growth stages such as flowering and grain filling (Oduniyi *et al.* 2019).

Understanding farmers' perspectives and adaptive strategies is critical in this situation. Conducting research in ward 27 of Greater Giyani Local Municipality provided a context-specific insight of the problems and opportunities confronting these small-scale farmers, as well as their coping and adaptation strategies to the negative consequences of climate change. This is especially relevant because most households rely on maize as their primary food source, making climate change a significant threat to their livelihoods.

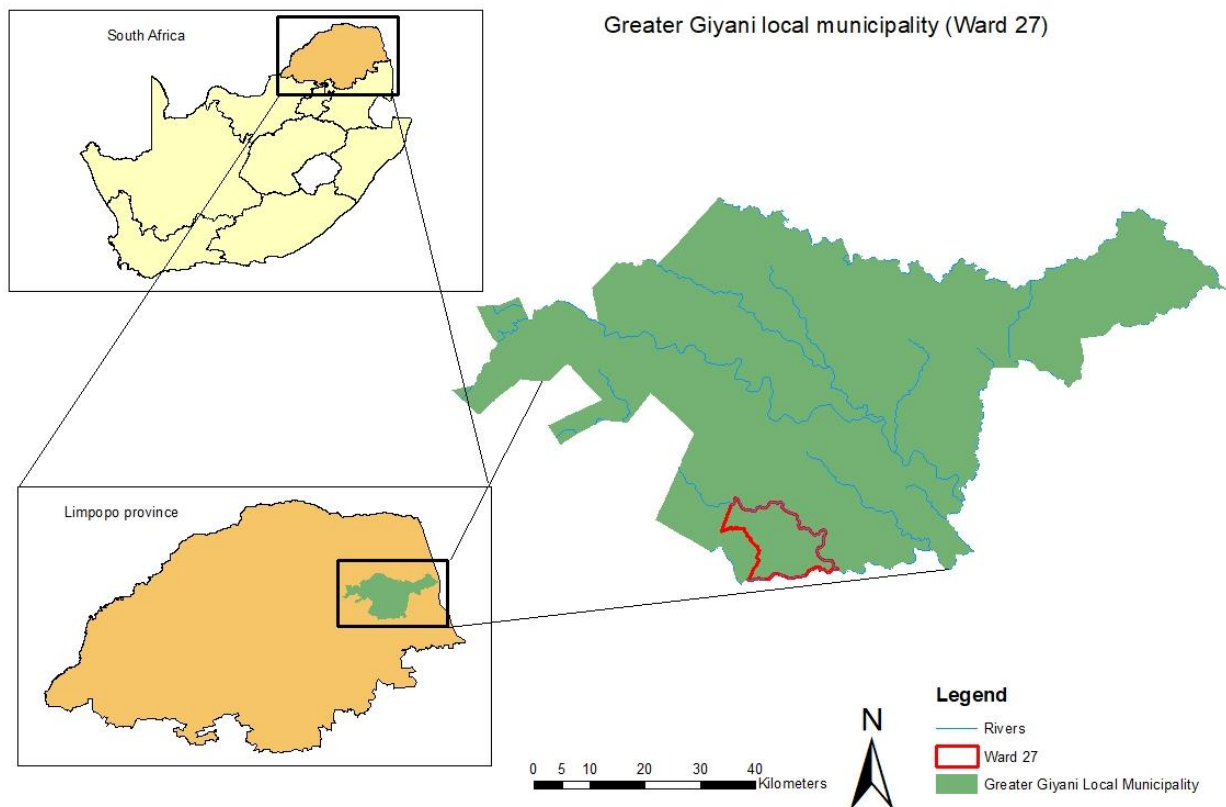


Figure 3. 1 Map of ward 27 of Greater Giyani local Municipality, Limpopo province, South Africa

3.3 Data collection

The primary data for this study was collected using structured questionnaires administered through face-to-face interviews. Data collection took place over four weeks, from mid-March to mid-April 2024, with a team of four enumerators fluent in the local Xitsonga language. A list of small-scale maize farmers from five villages was obtained from traditional leaders, headmen, and ward councillors. The questionnaire was organized into three sections, each addressing specific topics. The first section aimed to gather descriptive information about the socioeconomic characteristics of small-scale maize farmers. The second section examined the adaptation strategies employed by farmers to alleviate the negative impacts of climate change. Finally, the third section investigated the factors that shaped farmers' perceptions regarding the implementation of climate change adaptation strategies. The primary goal of the questionnaire was to collect detailed information about small-scale maize farmers' views on climate change adaptation strategies and their practical application.

To ensure the reliability and validity of the questionnaire, it underwent a thorough validation process. This included a pilot study conducted with a small group of farmers to test the clarity and effectiveness of the questions. Feedback from this pilot phase allowed for necessary adjustments to be made before the full-scale data collection began. Furthermore, validity was established by examining both content and face validity, ensuring that the questions accurately reflect the study's objectives and are relevant to the target population. This comprehensive approach to validating the questionnaire not only enhances the credibility of the findings but also provides a robust framework for understanding small-scale maize farmers' perceptions on climate change adaptation strategies in ward 27 of Greater Giyani Local Municipality.

3.4 Sampling frame

The list from which perspective respondents were chosen is known as a sampling frame (Kennedy, 2008). The sampling frame for this study was made up of all the households in the ward 27 of Greater Giyani Local Municipality. The decision to select a household as a sampling unit was important given that, according to the (FAO, 2008), most farming operations were performed at the household level, and this has a direct effect on farming and adaptation practices at the farm level. Ward 27 of the

Greater Giyani local Municipality had 1806 total households (Stats SA, 2022 /Census 2022). The selection of small-scale maize farmers was conducted using a probability proportional to sample size method, ensuring that the number of farmers chosen corresponded to the sample frame of each village. This approach established the villages as the units of analysis for the research. Consequently, a total of 130 small-scale maize farmers were chosen from five villages, determined through a feasibility study. The approach of using probability proportional to sample size for selecting small-scale maize farmers was inspired by the methodology employed by Nkoana *et al.* (2019) in their study on factors influencing households' willingness to purchase water and electricity in Moletjie, Aganang Municipality, Limpopo Province, South Africa.

The formula used to calculate the sample size for each village is as follows:

$$\text{Sample size} = \frac{\text{Household population per village}}{\text{Total Household population}} \times \text{Total sample size}$$

Table 3. 1 Sample Size of Villages in Ward 27 of Greater Giyani Local Municipality

Villages	Household Population	Sample size	Percentage (%)
Xitlakati	518	37	28.5
Khaxani	573	41	31.5
Mzilela	221	16	12.3
Matsotsosela	288	21	16.2
Mayephu	206	15	11.5
Total	1806	130	100

3.5 Sampling method

3.5.1 Snowball sampling

In this study, snowball sampling was utilized to effectively identify and recruit small-scale maize farmers in the five villages of ward 27. Snowball sampling is a non-probability sampling method commonly used in social research to reach populations that are difficult to access through traditional sampling techniques. This approach

begins with a small group of initial participants, referred to as "seeds," who are selected based on their relevance to the study or their connection to the target demographic. In this case, traditional authorities provided a list of 138 small-scale maize farmers from which the researcher identified these initial seeds. The researcher communicated the research topic, target population, and desired participant characteristics to the traditional authorities to ensure clarity.

Once the initial seeds were identified, they were asked to refer other small-scale maize farmers who met the study's criteria. This referral process continued until a sufficient number of participants were enrolled in the study. The use of snowball sampling in this context was particularly advantageous as it allowed for the inclusion of individuals who might be challenging to reach through conventional sampling methods, thereby enhancing the study's relevance and depth by capturing insights from a more representative segment of the small-scale maize farming community. Although snowball sampling was advantageous for reaching hard to access individuals within the study area, it also introduced certain biases that needed acknowledgement. One major concern was selection bias, as a method relied on referrals, which could lead to a homogenous sample and the underrepresentation of diverse perspectives, particularly from less connected farmers. Additionally, social desirability bias may have influenced participants to provide socially acceptable responses, skewing the data.

While snowball sampling proved valuable in accessing the target population of small-scale maize farmers, and Likert scales and Binary Logistic Regression offered quantifiable insights, it's crucial to acknowledge their inherent limitations. The potential for selection and social desirability biases in snowball sampling, coupled with the response biases and ordinal nature of Likert scale data, necessitates careful interpretation of the findings. Similarly, the assumptions underlying Binary Logistic Regression, and its sensitivity to outliers, must be considered when drawing conclusions. Recognizing these methodological constraints allows for a more nuanced understanding of the results and informs future research endeavors aimed at mitigating these limitations through alternative sampling techniques, more robust measurement scales, or advanced statistical modeling approaches. Further investigations could benefit from incorporating qualitative methods to provide richer, more contextualized insights into farmer perceptions and decision-making processes related to climate change adaptation

3.6 Analytical techniques

3.6.1 Descriptive statistics

To achieve the first objective of the socio-economic characteristics of small-scale maize farmers in ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa, descriptive statistics were conducted. These statistics included measures such as mean, maximum, minimum, standard deviations, frequencies, and percentages. These measures provided a comprehensive overview of the socioeconomic characteristics of the farmers, offering insights into central tendencies, variability, and distribution of the data.

3.6.2 Likert scale and Descriptive statistics

The study utilized a Likert scale to evaluate the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area. The Likert scale contained multiple statements relevant to the study, and respondents were requested to rate their degree of agreement with each statement. This rating ranged from strongly disagree to strongly agree (Joshi and Pal, 2015). A 5-point Likert scale questionnaire was used, offering the options of “Strongly disagree,” “Disagree,” “Uncertain,” “Agree,” and “Strongly agree.”

To calculate the mean of the Likert scale responses, the following formula was used: Mean = [(Number of respondents) x Sum of (score)] / (total number of participants). Mean = (SD*1 + D*2 + U*3 + A*4 + SA*5) / total number of participants, where SD = Strongly disagree, D = Disagree, U = Uncertain, A = Agree, and SA = Strongly agree.

Therefore, if the mean score is < 3.26, the farmers had a negative perception, and if the mean score is ≥3.26, the farmers had a positive perception. This decision was made based on the assumption that a mean score below 3.26 indicated a predominantly negative sentiment or disagreement with the statements assessed in the Likert scale. It suggested that, on average, the farmers expressed a more negative viewpoint regarding the application of climate change adaptation strategies.

The approach of using Likert scale to evaluate the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area was inspired by the study conducted in the Dabus watershed, Ethiopia by Asrat *et al.* (2018), researchers employed a five-point Likert scale to assess farmers' perceptions of climate change and their adaptation strategies. The mean scores derived from the

Likert scale responses were used to categorize farmers' perceptions as positive or negative, revealing a generally positive attitude towards adaptation measures.

3.6.3 Econometric model

This study employed a Binary Logistic Regression model to fulfil its third objective, which was to determine the factors influencing small-scale maize farmers' perceptions regarding the implementation of climate change adaptation strategies in the study area. According to Sperandei (2014), the Binary Logistic Regression model is utilized to calculate the odds ratio when multiple explanatory variables are present. This regression technique is effective for predicting the outcomes of a binary dependent variable based on independent variables that can be continuous, discrete, dichotomous, or a combination of these types (Retherford and Choe, 2011; Southavilay *et al.* 2012).

Numerous studies have successfully applied the Binary Logistic Regression model to analyze farmers' perceptions and adaptation strategies related to climate change. For example, research conducted in northern Uganda identified significant determinants affecting smallholder farmers' adaptation strategies, revealing that access to credit and extension services notably influenced their decisions (Atube *et al.* 2021). A study in northeastern Burundi utilized a Binary logistic model to explore how smallholder farmers perceive climate change, and the adaptation practices they implement, emphasizing the impact of agricultural education, farm size, and access to climate information on their adaptation choices (Batungwanayo *et al.* 2022).

Additionally, research in KwaZulu-Natal, South Africa, analyzed smallholder farmers' perceptions of climate change using binary logistic regression and found that socioeconomic factors such as age and education level significantly influenced their adaptation strategies (Maziya, 2021). Collectively, these studies highlight the importance of the Binary Logistic Regression model in understanding the intricate relationships between farmers' perceptions and their climate change adaptation strategies. In this study, the dependent variable is dichotomous, with a value of 1 indicating that small-scale maize farmers have a positive perception of climate change adaptation strategies, and 0 otherwise. The data were collected through a

questionnaire survey, yielding binary responses alongside a mix of discrete and continuous independent variables.

3.6.3.1 Binary Logistic regression model

The Binary logistic regression model is expressed as follows:

Equation (1)

$$\ln \left(\frac{p_i}{1-p_i} \right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots \beta_k x_k$$

Equation (2)

$$Y_i = \ln (p_i / 1 - p_i)$$

Where:

Y = Dependent variable (Farmers Perception)

$p_i / (1 - p_i)$ = is called the odds (likelihoods) ratio, p_i represents the probability of farmers perceiving the application of climate change adaptation strategies, then $1 - p_i$ represents the probability of farmers not perceiving the application of climate change adaptation strategies.

\ln = The natural logarithm

β_0 = The regression constant (Intercept)

μ = The disturbance term

$\beta_1 + \beta_2 + \beta_3, \dots, \beta_{14}$ = The regression coefficients for the independent variables

$X_1 + X_2 + X_3, \dots, X_{14}$ = The independent variable

3.6.3.2 Model specification

$$FMP = \beta_0 + \beta_1 AGE + \beta_2 GND + \beta_3 MRS + \beta_4 HSZ + \beta_5 EMS + \beta_6 LED + \beta_7 FMI + \beta_8 ATE + \beta_9 FSZ + \beta_{10} FATC + \beta_{11} AGT + \beta_{12} FME + \beta_{13} CCA + \beta_{14} FMC + Ut$$

Table 3. 2 Description of variables

		Variable	Description	Unit of measurement	Expected sign

Dependent variables					
<i>Y_{ik}</i>	FMP	Farmers Perception	1 if the small-scale maize farmers have positive perception on the application of climate change adaptation strategies, and 0 otherwise	Dummy	
Independent Variables					
<i>X₁</i>	AGE	AGE	Actual number of years	Number	+/-
<i>X₂</i>	GND	Gender	1 if the farmer is male, 0 if the respondent is female	Dummy	+
<i>X₃</i>	MRS	Marital status	0 if the farmer is single, 1 if married, 2 widowed and 3 divorced	Categorical	+/-
<i>X₄</i>	HSZ	Household Size	The actual number of household members	Number	+
<i>X₅</i>	EMS	Employment status	0 if the farmer is employed, 1 if unemployed, 2 if parttime employed, 3 if	Categorical	+

			temporary employed		
X_6	LED	Level of Education	0 if the farmer has no formal education, 1 for primary education, 2 for secondary, 3 for tertiary	Categorical	+
X_7	FMI	Farmer's income	Income per anum	Rands	+
X_8	ATE	Access to extension	1 if farmer has access to extension service; 0 otherwise	Dummy	+
X_9	FSZ	Farm size	The size of land owned by the farmers	Hectors	+
X_10	ATC	Access to credit	1 If the farmer has access to credit, 0 otherwise	Dummy	+
X_11	AGT	Agricultural trainings	1 if the farmer has access to training, 0 otherwise	Dummy	+
X_12	FME	Farming experience	Number of years in farming	Years	+
X_13	CCA	Climate change awareness	1 if the farmer is aware of climate change, 0 otherwise	Dummy	+

X_14	FMC	Farmer's cooperatives	1 if the farmer is in farmers' cooperative association, otherwise 0	Dummy	+/-
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3.7 Chapter summary

This chapter presented an overview of the study area and describes the research methodology utilized to achieve the study's objectives. It outlined the sources of data, the sampling techniques employed for primary data collection, and the analytical methods used. The research was conducted in Ward 27 of the Greater Giyani Local Municipality, situated in the Mopani District of Limpopo Province, South Africa. Ward 27 was specifically selected to investigate the experiences and challenges faced by small-scale maize farmers, providing insights into their resilience and adaptability. Primary data was gathered through structured questionnaires administered via face-to-face interviews. The questionnaire consisted of three sections designed to collect information on the socioeconomic characteristics of farmers, their adaptation strategies in response to climate change, and the factors determining their perceptions of these strategies. The sampling frame included all households in Ward 27, with participants chosen using a snowball sampling method. Descriptive statistics were applied to analyze the socioeconomic characteristics, while a Likert scale was utilized to assess farmers' perceptions of climate change adaptation strategies. Additionally, a binary logistic regression model was employed to identify the factors affecting small-scale maize farmers' perceptions regarding the implementation of climate change adaptation strategies in the study area.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter summarizes the findings from the descriptive statistical analysis presented in Chapter Three. The descriptive data were illustrated using frequency tables and graphs, which display both the percentage and frequency of each variable, as well as the means for certain variables. The application of descriptive statistics aimed to emphasize the key characteristics of the study's data and provide clear descriptions of the variables and measures involved. Socioeconomic data were gathered from small-scale maize farmers sampled in ward 27 of the Greater Giyani Local Municipality. A Likert scale analysis was utilized to evaluate these farmers' perceptions of climate change adaptation strategies within the study area. Additionally, this chapter includes results from the Binary logistic regression model, which analyzed the factors affecting small-scale maize farmers' perceptions of climate change adaptation strategies. The empirical results from the logistic regression model were presented in tabular form, including tests for multicollinearity, Chi-square tests for model fit, estimated coefficients, likelihood coefficients, and p-values to highlight significant variables.

4.2 The socio-economic characteristics of small-scale maize farmers

Table 4. 1: Frequency table for continuous variables of small-scale maize farmers

Variable	Minimum	Maximum	Mean	Std. Deviation
Age	23	85	57	17
Household size	1	10	4.65	1.8
Farm size	1	21	4.22	3.2

Table 4.1 shows the age distribution of small-scale maize farmers in ward 27 of Greater Giyani local Municipality. The data is based on a total of 130 farmers, with the ages ranging between 23 years to 85 years. The mean age of the farmers is 57 years, showing that the average farmers in the study area is an elderly person. This indicates that the farming population is primarily dominated by older people. The considerable

standard deviation of 17 years demonstrates a wide range of farmer ages, emphasising the existence of both young and old farmers in the community. This variance is important for understanding the dynamics and requirements of the farming population. The distribution in the study could be good for use of climate change adaptation strategies, because Adeagbo *et al.* (2021) reported that agricultural experience has favourable and substantial influence on adoption of climate change adaptation strategies.

Table 4.1 also depicts the household size distribution among small-scale maize farmers in ward 27 of Greater Giyani Local Municipality. The household size ranged from 1 to 10 members. The average household size was 4.65 members, implying that the average household consists of around 5 people. This shows that the farming population is primarily made up of moderate-sized households. The standard deviation of 1.8 people shows a moderate variety in household sizes, indicating the presence of both smaller and larger households in the study area.

The minimum household size of 1 member indicates the presence of relatively small households that may experience difficulties in providing adequate labour for farming activities. On the other hand, the maximum household size of 10 individuals indicates the presence of larger households capable of providing a more considerable labour force. However, because of the increasing number of dependents, these larger households may experience additional financial burden.

The farm size distribution of small-scale maize farmers in ward 27 of the Greater Giyani Local Municipality is also presented in Table 4.1, the average farm size was 4.22 hectares. The standard deviation of 3.2 hectares indicates a significant diversity in farm size, demonstrating the presence of both small and large farms in the community. This small-scale farming is typical of subsistence agriculture, in which farmers produce largely for their own consumption, with a minor surplus for sale. The huge diversity in farm sizes, as demonstrated by the standard deviation, suggests that while many farmers run small to medium-sized farms, a few manage much larger holdings. The minimum farm size of 1 hectare indicates the presence of very small farms that may struggle to achieve economies of scale and have limited resources for technology and input investment. However, the maximum farm size of 21 hectares

indicates the presence of farmers with substantially bigger land holdings, who may have more resources and the potential for higher output levels.

4.2.1 Gender of small-scale maize farmers

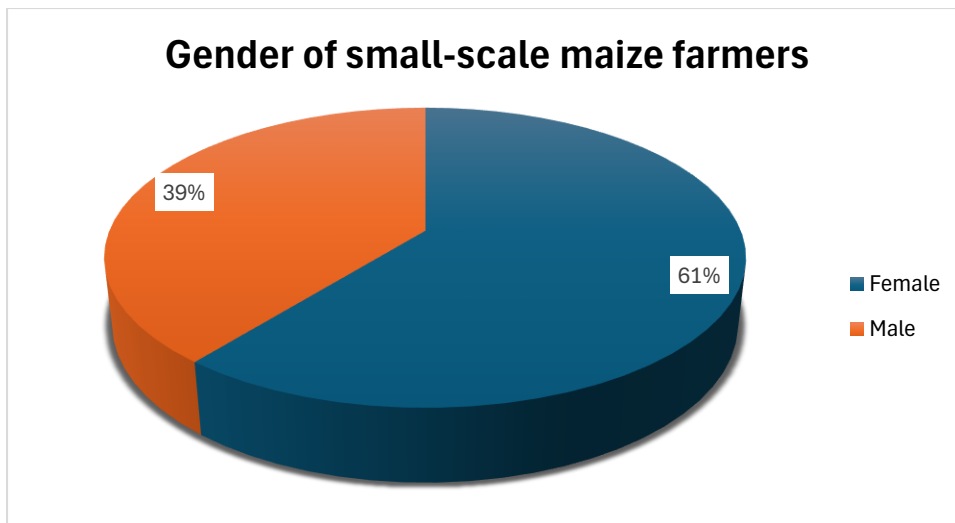


Figure 4.1 Gender of small-scale maize farmers (n =130)

The results in Figure 4.1 indicate that from the 130 sampled small-scale maize farmers in the study area, about 61% of the small-scale maize farmers in ward 27 of Greater Giyani local Municipality were female and 39% were male. As a result, these findings suggest that women were more actively engaged in maize farming than men.

4.2.2 Marital status of small-scale maize farmers

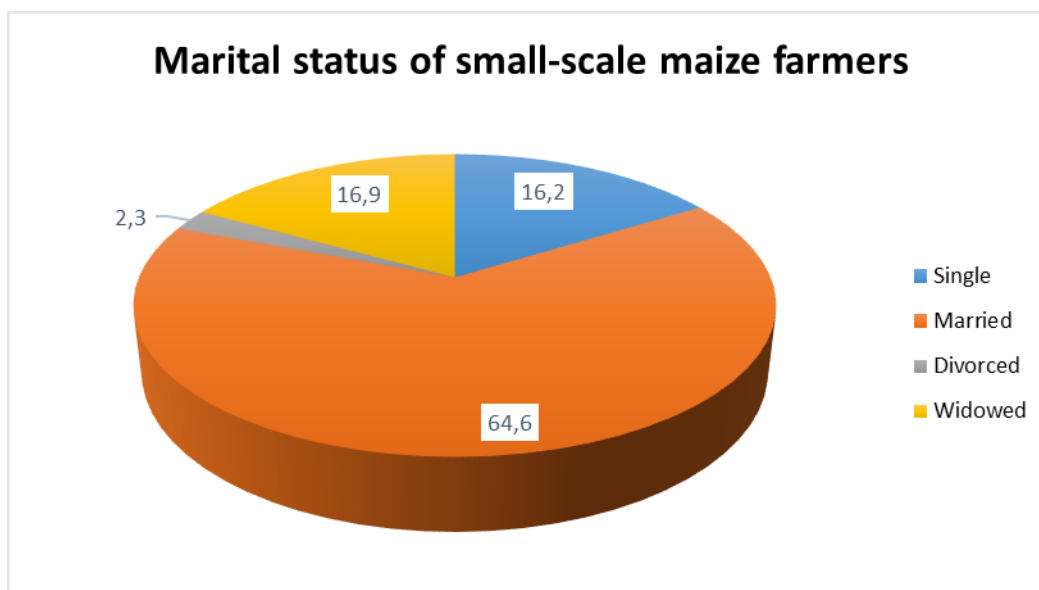


Figure 4. 2 Marital status of small-scale maize farmers

The Figure 4.2 details the marital status of the small-scale maize farmers in ward 27 of Greater Giyani Local Municipality. Among the 130 sampled farmers, 2.3% were divorced, 16.2% were single, 16.9% were widowed, and 64.6% were married. The results generally imply that most of the small-scale farmers in the study area were married and their partners could have influence on their perception

4.2.3 Educational level of small-scale maize farmers

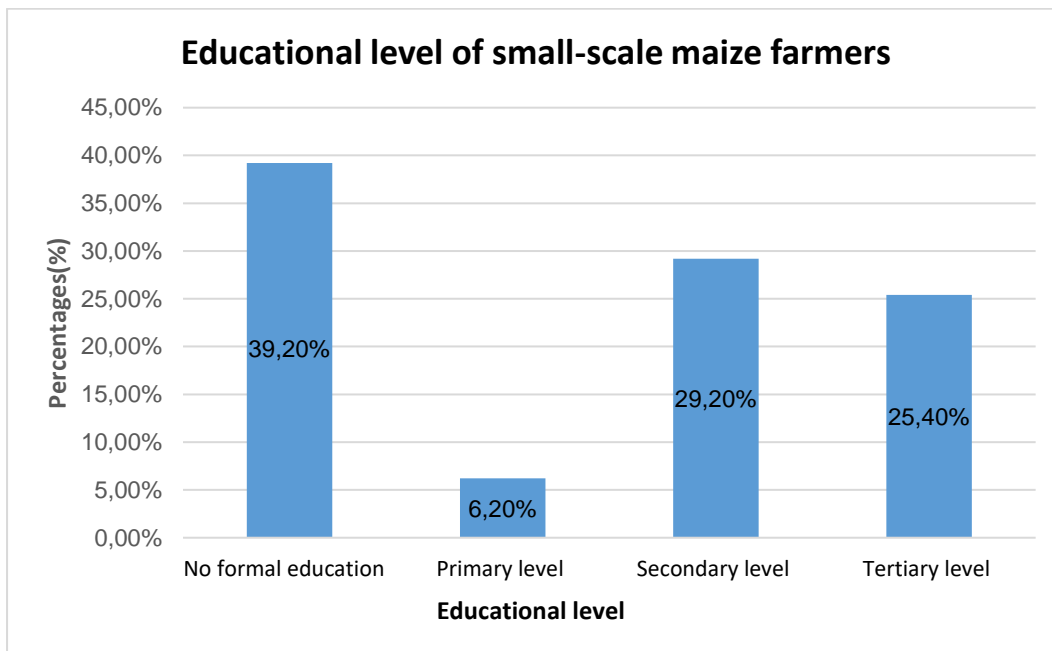


Figure 4. 3 Educational level of small-scale maize farmers

Figure 4.3 shows the educational levels of small-scale maize farmers in ward 27 of Greater Giyani Local Municipality. More precisely, 39.2% of these farmers have no formal education, 6.2% have primary education, 29.2% have secondary education, and 25.4% have tertiary education. The high percentage of farmers who lack formal education (39.2%) could be a major barrier to understanding and implementing complex climate change adaptation techniques. However, Cumulatively, most farmers in the area had secondary and tertiary education, which could improve their access, understanding, and implementation of modern agricultural practices and technology required for effective adaptation.

4.2.4 Employment status of small-scale maize farmers

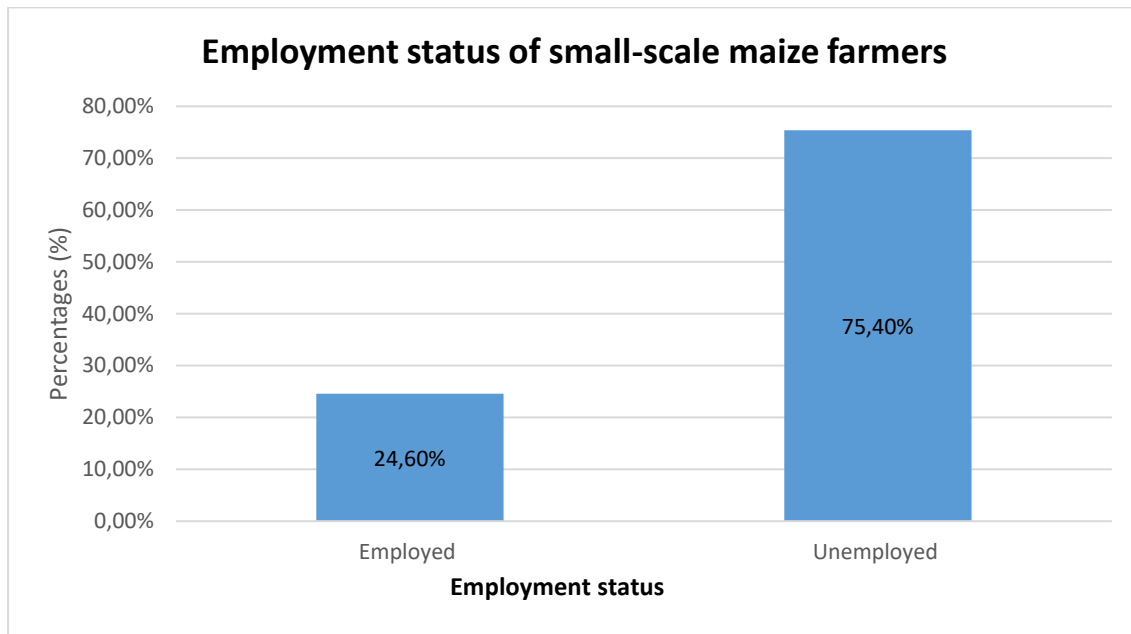


Figure 4. 4 Employment status of small-scale maize farmers

The Figure 4.4 present the employment status of small-scale maize farmers in ward 27 of Greater Giyani Local Municipality. The results show that from the selected small-scale farmers, approximately three quarter of them were unemployed (74.4%) whereas less than a quarter of sampled farmers were employed (24.6%). This suggests most of small-scale maize farmers in the study area depends on farming for their livelihood.

4.2.5 Farmers experience in maize production

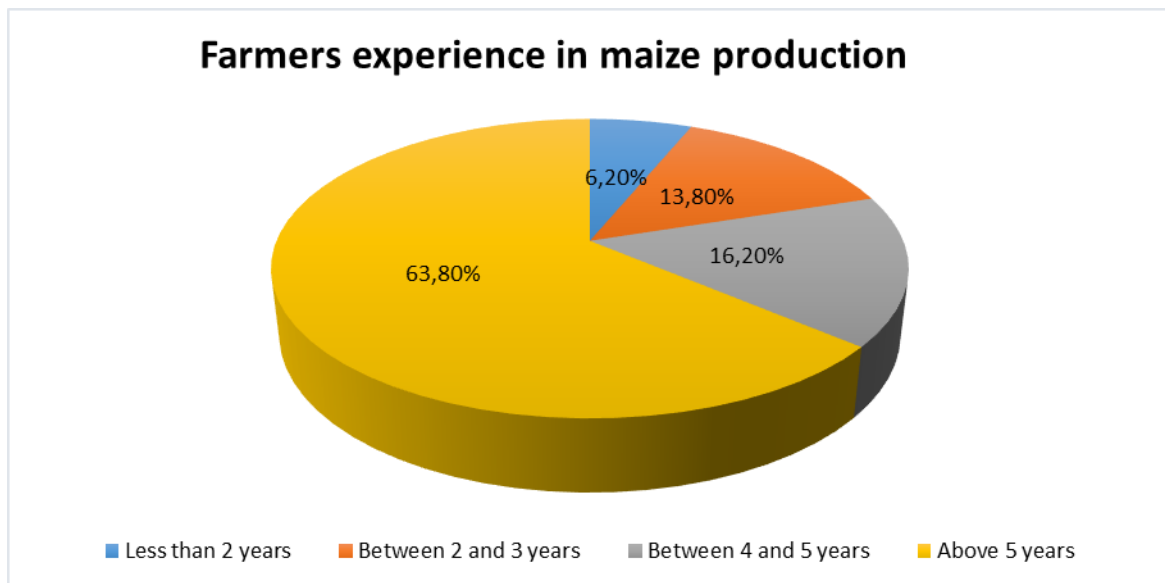


Figure 4. 5 Farmers experience in maize production

Figure 4.5 shows the findings regarding the experience levels of small-scale maize farmers in ward 27 of Greater Giyani Local Municipality which provide valuable insights into their capacity to implement climate change adaptation strategies. Among the surveyed farmers, 63.8% have over 5 years of experience in maize production, which suggests a solid foundation of knowledge and practical skills that could facilitate the adoption of effective adaptation strategies.

Additionally, 16.2% possess between 4 and 5 years of experience, indicating they are also well-acquainted with farming practices and likely understand the challenges posed by climate change. Furthermore, 13.8% of the farmers have between 2 and 3 years of experience, showing a developing familiarity with maize cultivation, while only 6.2% have less than 2 years of experience, reflecting a limited number of newcomers in this field. This distribution of experience suggests that the majority of farmers are well-positioned to engage with and apply climate change adaptation strategies, as their extensive background may enhance their ability to recognize and respond to climatic challenges.

4.2.6 Access to credit for farmers

Table 4. 2 Access to credit for farmers

Outcomes	Frequency	Percentage
Yes	37	28.5%
No	97	71.5%

The table 4.2 above depicts small-scale maize farmers' access to credit in ward 27 of Greater Giyani Local Municipality, which has significant consequences for their agricultural production and resistance to climate change. With only 28.5% of farmers having access to credit and, a large proportion of the farmers (71.5%) reported not to have access to credit.

The absence of finance not only reduces current output but also limits long-term sustainability initiatives (Khan *et al.* 2024). Farmers without monetary assistance find it difficult to implement contemporary agricultural technologies such as irrigation systems or improved crop types, which are critical for managing the effects of climate variability, such as droughts and unpredictable weather patterns (Ruzzante *et al.* 2021). Furthermore, without appropriate funding, farmers find it difficult to invest in soil conservation strategies or sustainable farming techniques that can protect natural resources and increase land production over time (Dhillon and Moncur, 2023).

4.2.7 Access to extension service for small-scale maize farmers

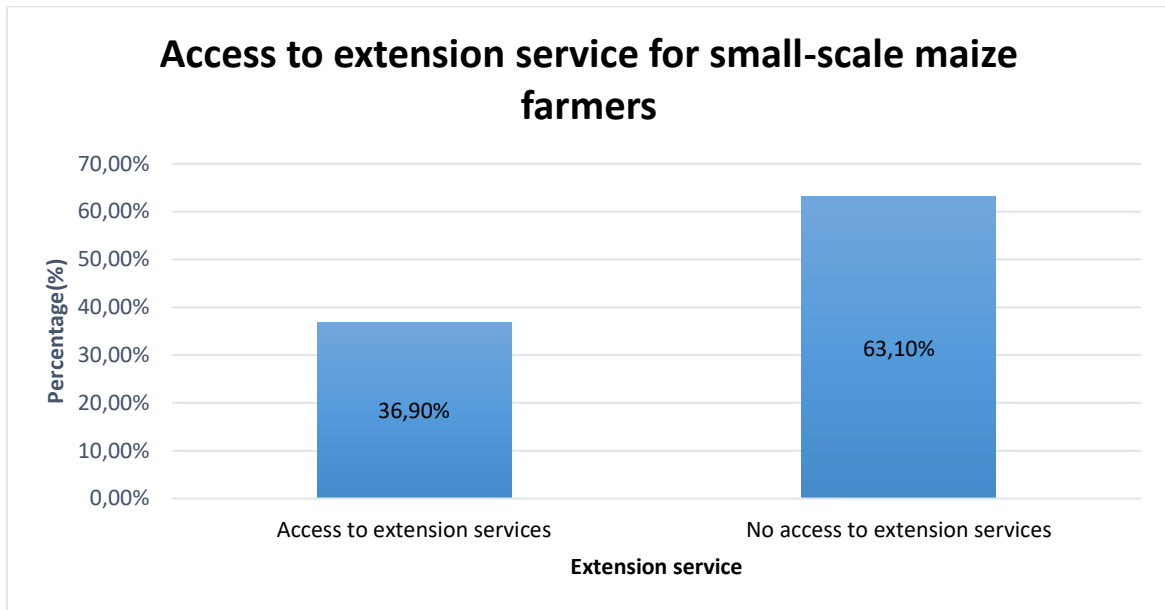


Figure 4. 6 Access to extension service for small-scale maize farmers

According to Figure 4.6, 63.1% of small-scale maize farmers in ward 27 of Greater Giyani Local Municipality do not have access to extension services, while 36.9% do. This considerable disparity shows that a large proportion of farmers are not receiving critical information and advice on climate adaptation strategies from the extension officers. Literature have emphasised the need of extension services in communicating information about climate risks, adaptable farming techniques, and farmer aid programmes (Nkosi *et al.* 2022). Farmers lacking access to extension services are less likely to adopt innovative agricultural practices and essential skills for climate change adaptation, as these services provide crucial support in pest control, crop management, and climate awareness (Qwabe *et al.* 2022; Noko, 2023; Mgalama, 2014).

4.2.8 Farmers income per month

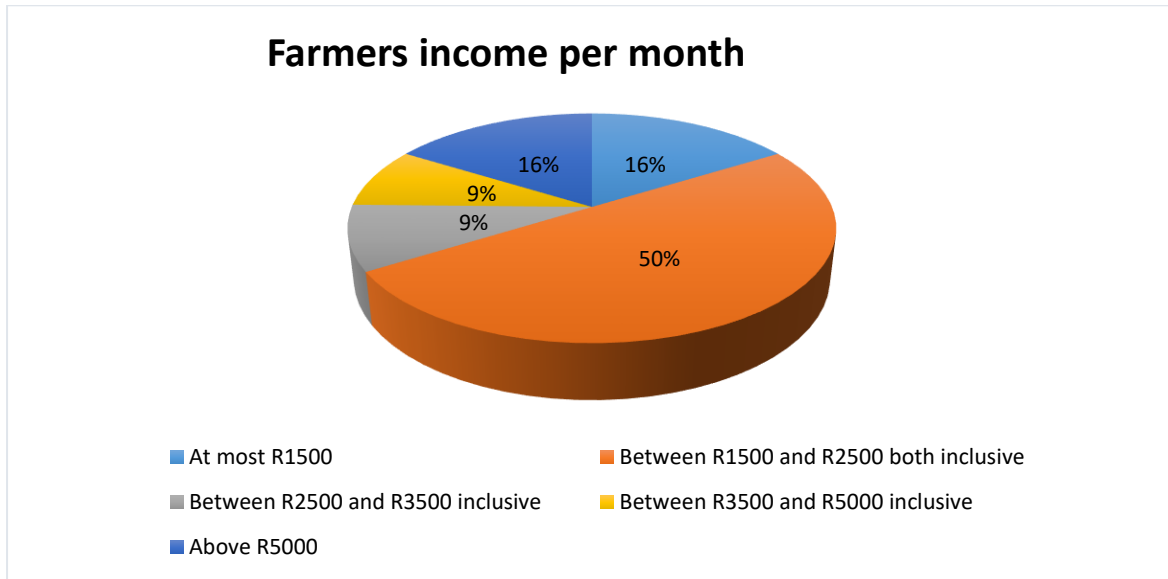


Figure 4. 7 Farmers income per month

The results on Figure 4.7 shows the income distribution among small-scale maize farmers in ward 27 of Greater Giyani Local Municipality per month. A sizable amount of small-scale maize farmers (50%) earns an income of between R1500 and R2500 which is below the minimum living wage in South Africa. The findings further reveal that 16% of the sampled farmers earned above R5000 which may not be sufficient considering the economic status of the Greater Giyani local municipality. The research indicates that there are equal percentages of farmers earning between R2,500 to R3,500 and R3,500 to R5,000. This suggests a relatively balanced distribution among these income brackets but still highlights that most farmers are earning below what is necessary for a sustainable livelihood. Limited financial resources may limit access to critical inputs such as drought-resistant seeds, fertilisers, and irrigation systems, all of which are essential for adapting to changing climate conditions (Mpala and Simatele, 2024).

4.2.9 Farmers access to agricultural training

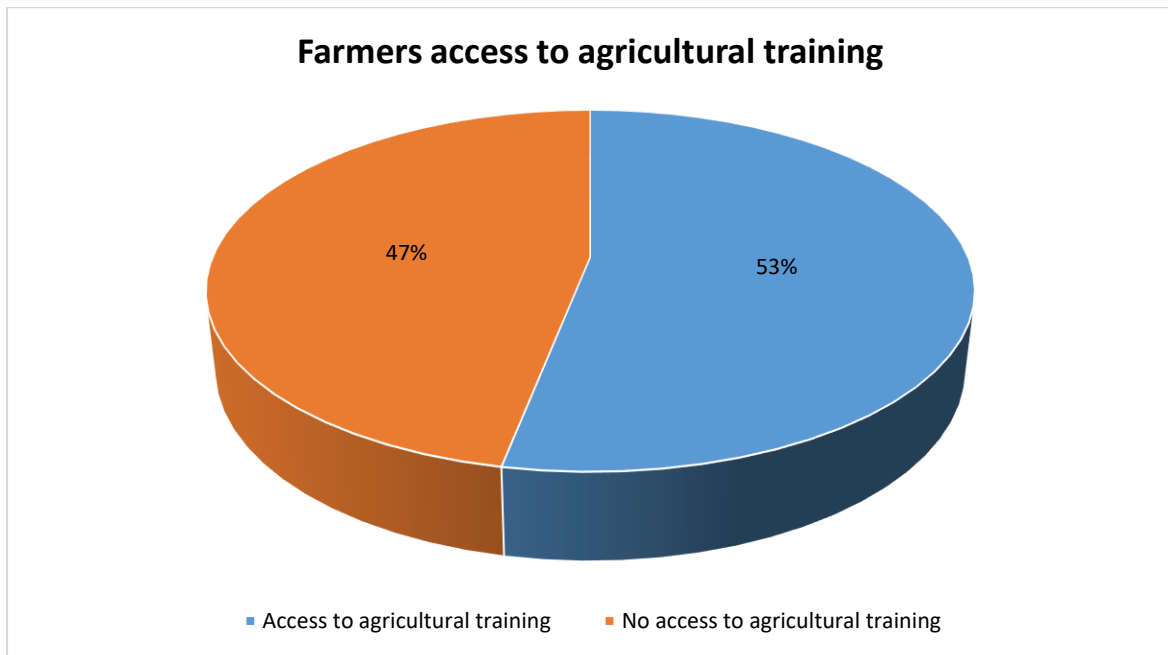


Figure 4. 8 Farmers access to agricultural training

Figure 4.8 depicts access to agricultural training among small-scale maize farmers in ward 27 of Greater Giyani Local Municipality, demonstrating that 53 % have received agricultural training and 47 % have not. This suggests that a substantial number of farmers are missing out on important knowledge and skills that could enhance their farming practices, particularly regarding strategies for adapting to climate change in their area. The difference in access to training highlights a significant gap in support and resources available to these farmers.

4.2.10 Farmers access to weather forecast

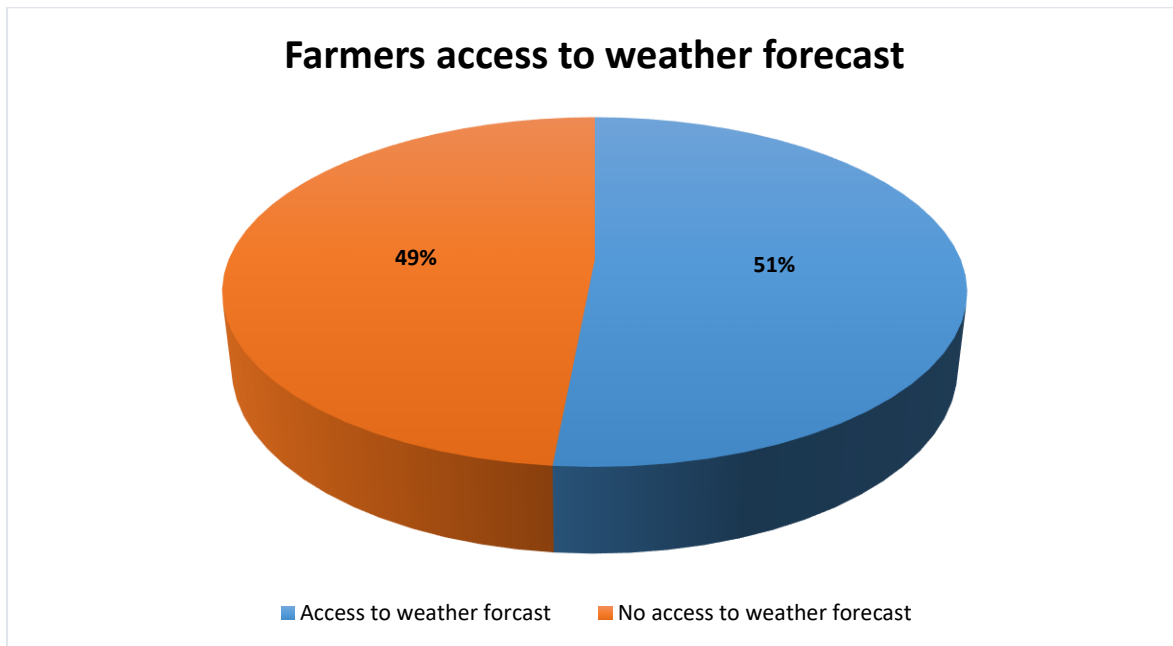


Figure 4. 9 Farmers access to weather forecast

Figure 4.9 above illustrates access to weather forecasts among small-scale maize farmers in ward 27 of the Greater Giyani Local Municipality. The data indicates that 51% of farmers have access to weather forecasts, while 49% do not. This nearly equal distribution indicates that just over half of the farmers benefit from weather information necessary for effective agricultural planning and decision-making.

Farmers with access to weather forecasts are likely positioned to make informed choices regarding critical agricultural activities, such as planting and harvesting. The availability of accurate weather predictions enables them to anticipate adverse conditions, allowing for timely preparations against events like droughts and floods, which can mitigate potential crop losses (Brown, 2021; Surendra, 2024).

Conversely, the 49% of farmers lacking access to weather forecasts face challenges that suggest a reliance on traditional knowledge or guesswork. This lack of reliable information may lead to inefficient planting and harvesting practices, increasing their vulnerability to weather-related risks and potentially diminishing overall agricultural productivity (Agyekum *et al.* 2022; Ivanchuk, 2023). The results highlight a significant gap in access to weather forecast information among small-scale maize farmers,

underscoring its importance for enhancing their ability to respond effectively to climatic variability.

4.2.14 Adaptation strategies adopted by small-scale maize farmers in the study area

Table 4. 3 Adaptation strategies adopted by small-scale maize farmers in the study area

Adaptation strategies adopted by farmers in study area	Number of times mentioned by farmers	Percentage (%)
Crop diversification	100	32.4
Change planting time	60	19.4
Water management	39	12.6
Improved irrigation practices	46	14.6
Use climate resilient crop varieties	33	10.7
Adjust farming practice	10	3.2
Other adaptation strategies	22	7.1
Total	310	100

Table 4.3 presents the adaptation strategies used by small-scale maize farmers in the study areas. The results indicate crop diversification was used by most farmers in the study (32.4%). While changing planting time was found to be the second most used method by farmers accounting for 19.4% of the farmers. Water management and Improved irrigation practices were adopted by 12.6% and 14.6% of the small-scale farmers respectively. Further analysis reveals that 10.7% of farmers are using climate-resilient crop varieties, 3.2% have adjusted their farming practices, and 7.1% have employed other adaptation strategies such as organic manure and composting. Generally, farmers in the study area have adopted ways to manage the effects of climate change in the study, implying that farmers are interested in protecting their produce against risk associated with climate change. This proactive approach reflects

their commitment to enhancing agricultural resilience and ensuring sustainable farming practices in the face of changing environmental conditions.

The adaptation strategies adopted by small-scale maize farmers in the study area show both similarities and differences with previous research. Crop diversification is the most commonly used strategy in this study, employed by 32.4% of farmers, which aligns with other studies where diversification is recognized as a prevalent adaptation measure (Oduniyi and Tekana, 2019; Akanbi *et al.* 2021). Changing planting times, used by 19.4% of farmers, is also a widely adopted strategy across studies (Ndhleve *et al.* 2017; Oduniyi and Tekana, 2019). On the other hand, adjusting farming practices is one of the least adopted strategies in this study, with only 3.2% of farmers implementing it, a trend also observed in other research where this strategy is not frequently highlighted. The use of organic manure and composting, employed by 7.1% of farmers, is another relatively underutilized strategy. While there is consensus on the effectiveness of certain strategies like crop diversification, the adoption rates and emphasis on specific strategies vary significantly between regions, reflecting the importance of tailoring adaptation measures to local conditions and farmer preferences.

4.3 Likert scale results on small-scale maize farmers perception on the application of climate change adaptation strategies in the study area

The Likert scale results for small-scale maize farmers in ward 27 of Greater Giyani Local Municipality presented in Table 4.4 provides the context on the farmers perceptions towards the application of climate change adaptation strategies. The study is based on responses to five statements, ranging from Strongly Disagree (SD) to Strongly Agree (SA). The mean scores and standard deviations for each statement indicate whether farmers' perceptions are typically positive or negative.

Table 4. 4 Small-scale maize farmers' perception on the application of climate change adaptation strategies in the study area.

Statements	Rating				Mean Score	σ	Decision

	SD 1	D 2	U 3	A 4	SA 5			
1. I believe that climate change adaptation strategies are necessary for long-term sustainability of my farm	3 (2.3%)	14 (10.8%)	10 (7.7%)	58 (44.6%)	45 (34.6%)	3.98	1.03	Positive perception
2. I am willing to adopt and implement climate change adaptation strategies on my farm	2 (1.5%)	19 (14.6%)	12 (9.2%)	72 (55.4%)	25 (19.2%)	3.76	0.98	Positive perception
3. I feel knowledgeable about the different climate change adaptation strategies that can be applied on my farm	60 (46.2%)	43 (33.1%)	10 (7.7%)	10 (7.7%)	7 (5.4%)	1.93	1.16	Negative perception
4. I perceive climate change adaptation strategies to be effective in mitigating the impact of climate change on my farm	2 (1.5%)	26 (20%)	28 (21.5%)	56 (43.1%)	18 (13.8%)	3.48	1.01	Positive perception
5. I believe that climate change adaptation strategies are practical and feasible to implement on my farm	16 (12.3%)	31 (23.8%)	16 (12.3%)	54 (41.5%)	10 (10%)	3.13	1.24	Negative perception

Note: N=130, SD = Strongly disagree, D = Disagree, U = Uncertain, A = Agree, and SA = Strongly agree. Decision: weighted average = $16.28/5 = 3.26$, therefore the decision will be Positive perception if the mean score is ≥ 3.26 , then negative perception if the mean score is < 3.26 .

Most small-scale maize farmers (79.2%) cumulatively agreed that climate change adaptation strategies are necessary for the long-term sustainability of their farms, while 20,8% had a different view about the statement. The high mean score of 3.98 suggested a strong positive perception, implying that most farmers saw the relevance of these strategies in maintaining their agricultural activity.

A large percentage of farmers (74.6%) indicated their willingness to adopt and implement climate change adaptation strategies on their farms. Additionally, the mean score of 3.76 represented a positive perception, indicating that most farmers were willing to incorporate these ideas into their farming practices. On the other hand, the findings show a lack of confidence among small-scale maize farmers on the knowledge of climate change adaptation strategies, with 79.3% strongly disagreeing or disagreeing with the statement. The low mean score of 1.93 suggested a negative perception, implying that many small-scale maize farmers were not well-informed about various strategies that may be used on their farm. This knowledge gap constituted a substantial hurdle, which was frequently worsened by insufficient training programmes and limited access to extension services, impeding effective adaptation.

Over half of the farmers (56.9%) stated that climate change adaptation strategies were effective in mitigating the effects of climate change on their farms. The average score of 3.48 suggested a positive perception, indicating confidence in the effectiveness of these strategies.

The replies expressed varying opinions on the practicality and feasibility of implementing climate change adaptation techniques. Although 51.5% of farmers agreed or strongly agreed, an impressive 36.1% disagreed or strongly disagreed. The mean score of 3.13 was slightly below the threshold for a positive perception, reflecting general doubt regarding the practicality of these strategies in their farms. Financial constraints, difficulties in obtaining financing, and a lack of comprehensive government

support all played an important part in forming these perspectives, emphasising the practical obstacles farmers faced.

Table 4. 5 Overall perceptions of small-scale maize farmers on the application of climate change adaptation strategies in the study area.

Statement	Agree+ Strongly disagree (%)	Uncertain (%)	Disagree + Strongly Disagree (%)	Positive Perceptions (%)	Negative Perceptions (%)
Necessity of Climate Change Adaptation Strategies	79.2	7.7	13.1	79.2	13.1
Willingness to Adopt Strategies	74.6	9.3	16.1	74.6	16.1
Knowledge of Adaptation Strategies	13.1	7.7	79.3	13.1	79.3
Effectiveness of Strategies	56.9	20.0	21.5	56.9	21.5
Practicality and Feasibility of Strategies	51.5	12.3	36.1	51.5	36.1
Average Perception	55.1	11.7	33.2	55.1	33.2

Table 4.5 summarizes the overall perceptions of the small-scale maize farmers regarding the application of climate change adaptation strategies. The findings reveal that 55.1 % of the small-scale maize farmers in the study area had positive perceptions on the application of climate change adaptation strategies, while 33.2% had negative perceptions. Additionally, 11.7 % of the small-scale farmers were uncertain about the effectiveness or practically implementing these adaptation strategies. This shows that most of the small-scale farmers in the study area are open to or supportive of adaptation strategies, though a significant portion remains either skeptical or unsure.

When comparing these findings to previous studies, there are both similarities and differences. Similarities include the general recognition of the importance of adapting to climate change among small-scale farmers, with many acknowledging the impacts of climate variability on their farming practices (Noko, 2023; Temba and Said, 2023). However, differences arise in the level of awareness and specific perceptions. For instance, some studies report higher levels of agreement on climate change impacts, such as in Tanzania where 69% of smallholder farmers strongly agreed that climate change has altered conditions significantly (Tema and Said, 2023). Additionally, the specific adaptation strategies adopted can vary significantly between regions, with some emphasizing irrigation and drought-resistant varieties (Noko, 2023), while others focus on crop diversification and changing planting times (Oduniyi and Tekana, 2019). Overall, while there is a consensus on the need for adaptation, the level of perception and specific strategies adopted can differ based on regional contexts and socio-economic factors.

4.4 Results on factors influencing the small-scale maize farmers perception on the application of climate change adaptation strategies in the study area

Table 4. 6 Analysis to determine the degree of multicollinearity on the small-scale maize farmers in ward 27 of Greater Giyani Local municipality.

Explanatory variable	Collinearity Statistics	
	VIF	1/VIF
Age	3,62	0,28
Gender	1,19	0,84
Marital status	1,44	0,69
Household size	1,30	0,77
Employment status	2,16	0,46
Level of education	2,80	0,36
Farmer's income	1,54	0,65
Access to extension services	2,25	0,44
Farm size in hectares	1,45	0,70
Access to credit	1,98	0,50
Agricultural trainings	2,35	0,43

Farming experience	1,80	0,56
Climate change awareness	1,60	0,62
Adaptation strategies	1,29	0,78
Access to Weather forecast	1,36	0,74
Farmer's Cooperatives	1,60	0,63
Mean VIF	1,85	0,59

To assess multicollinearity, the variance inflation factor (VIF) for each variable was determined. A VIF number greater than 10 denotes the existence of multicollinearity. However, the results revealed that all variables had VIFs less than 10, with an average VIF of 1.86 and an inverse VIF of 0.59. This shows that multicollinearity was not an issue among the variables.

Table 4. 7 Omnibus Tests of Model Coefficients results

Omnibus Tests of Model Coefficients			
	Chi-square	df	Sig.
Model	66,418	15	<,001

The Omnibus Tests of Model Coefficients were used to assess the fitness of the Binary logistic regression model. The Chi-square statistic was used to conduct the assessment, and the result with a value of 66.418 and a p-value less than 0.005 were obtained. These findings show a highly significant association between the dependent variable and the collection of independent variables in the model. The high Chi-square value, together with the extremely low p-value, highlights the model's usefulness in explaining the variability in the dependent variable, validating the predictors' robustness and statistical significance.

Table 4. 8 Model Summary Results

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
103,700a	0,40	0,548

The Model Summary uses pseudo-R-square statistics to assess the performance of the Binary logistic regression model in explaining variation in the dependent variable. In this analysis, the Cox and Snell R-square is 0.40, whereas the Nagelkerke R-square is 0.548. Nagelkerke's R-square of 0.548 indicates that the independent variables in the model account for approximately 54.8% of the variance. This result suggests that the Binary logistic regression model has strong explanatory power, demonstrating that the independent variables together explain a significant percentage of the variability in the dependent variable and validating the model's efficiency in capturing significant correlations between the independent factors and the dependent variable.

Table 4. 9 Hosmer and Lemeshow Test results

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	8,812	8	0,358

The Hosmer-Lemeshow Test is an important diagnostic tool for determining the goodness of fit for a Binary logistic regression model. The Chi-square value of 8.812 with 8 degrees of freedom and a p-value of 0.358 is presented in Table 4.8. This significant value, which is substantially above the 0.05 level, suggests that the logistic regression model adequately fits the data. The non-significant p-value indicates that there is no significant difference between the observed and predicted values, which supports the model's validity (Hosmer and Lemeshow, 2000; Menard, 2010).

4.4.1 Binary regression results

Table 4. 10 Binary regression results on factors influencing the small-scale maize farmers' perception on the application of climate change adaptation strategies.

Explanatory variables	B	S.E.	Wald	Sig.	Exp(B)
Constant	-2,244	2,158	1,082	0,298	0,106
Age of the farmer	-0,005	0,029	0,037	0,847	0,995
Gender of the farmer	-0,111	0,536	0,043	0,836	0,895
Marital Status	-0,863	0,458	3,551	0,06*	0,422
Household size	-0,088	0,168	0,271	0,603	0,916
Employment status	-2,364	0,987	5,736	0,017**	0,094
Level of Education	-0,211	0,298	0,501	0,479	0,81
Farmer's Income	0,262	0,299	0,767	0,381	1,3
Access to extension services	0,286	0,712	0,161	0,688	1,331
Farm size in hectares	-0,04	0,088	0,204	0,651	0,961
Agricultural trainings	0,585	0,79	0,548	0,459	1,795
Farming experience	0,378	0,253	2,226	0,136	1,459
Climate change awareness	0,751	0,785	0,915	0,339	2,12

Access to weather forecast	3,092	1,099	7,911	0,005***	22,021
Farmer's cooperatives	1,452	0,669	4,711	0,03**	0,234
Note: ***, **, * are significant levels at 1%, 5%, and 10%, respectively					

4.4.1 Significant variables

4.4.1.1 Marital status of small-scale maize farmers

The marital status of small-scale maize farmers was marginally significant at the 10% level ($p = 0.06$), with a negative coefficient ($B = -0.863$). This indicates that being married, divorced, or widowed is likely to negatively influence the perception of climate change adaptation strategies when compared to single farmers. The odds ratio ($\text{Exp}(B) = 0.422$) shows that these groups are 57.8% less likely to have a positive perception than single farmers. The marginal effect demonstrates that transitioning from single to married, divorced, or widowed reduces the likelihood of having a positive perception. Similarly, Saguye (2017) indicated that marital status had a marginally significant negative impact on farmers' perceptions of climate change adaptation strategies implying that marriage may lessen farmers' perceptions of the need to adapt to climate change. Married farmers may prioritise household responsibilities and urgent family demands above long-term adaptation strategies. The responsibilities of family life may limit their time, money, and inclination to participate in extra climate change adaptation initiatives. Recent research by Owusu, (2021) also indicated that family duties can distract farmers from climate perception efforts.

4.4.1.2 Employment status of small-scale maize farmers

The employment status of small-scale maize farmers in the study area was found to be statistically significant at the 5% level ($p = 0.017$), with a negative coefficient ($B = -2.364$). This suggests that being employed reduces the farmers' likelihood to perceive the application of climate change adaptation strategies. The odds ratio of 0.094

indicates that employed farmers are 90.6% less likely to recognise the need for perceiving the application of climate change adaptation strategies than unemployed farmers. This empirical finding concurs with Abid *et al.* (2015) and Zagre *et al.* (2024), who discovered that farmers' perceptions of climate change adaptation strategies were negatively influenced by their employment status. Specifically, both studies found that employed farmers were much less likely to perceive the need for adaptation strategies than unemployed farmers. This shows that employment may lower farmers' perception of the importance of climate change adaptation strategies. Furthermore, employed small-scale maize farmers may rely on alternative income streams and may not see an immediate need to adapt their strategies to climate change. Employment outside of farming can reduce reliance on agricultural revenue, hence reducing the perceived urgency of climate adaptation (Xu *et al.* 2022)

4.4.1.3 Access to weather forecast

Access and use of weather forecast information is an important adaptation strategy for maize farmers. According to Hewitt *et al.* (2023), climate information, including observations and monitoring of the climate system, is critical for developing reliable short-term weather forecasts on daily, monthly, and seasonal timescales. The findings of the study show that access to weather forecasts is statistically significant at the 1% level ($p = 0.005$) and has a positive coefficient ($B = 3.092$). This suggests that having access to weather forecasts increases the likelihood of holding a positive view towards climate change adaptation strategies. The odds ratio of 22.021 indicates that small-scale maize farmers with access to weather forecast information are over 22 times more likely to have a positive perception regarding the application of climate change adaptation strategies. This outcome aligns well with Adeosun *et al.* (2023) who revealed that the use of weather forecasting information helps farmers make informed decisions regarding planting, harvesting and other farm management activities.

4.4.1.4 Access to farmers cooperatives

The findings of the study indicates that access to farmer cooperatives is statistically significant at the 5% level ($p = 0.03$) and has a positive coefficient ($B = 1.452$). This implies that small-scale maize farmers who are members of cooperatives are more likely to positively view the use of climate change adaptation strategies. The odds ratio of 4.274 indicates that cooperative members are more than four times as likely to have a positive perception regarding the application of climate change adaptation

strategies. Access to farmers' cooperatives was critical for small-scale maize farmers because they provided a forum for sharing resources, support, and information on climate change adaptation strategies. Cooperatives' shared resources and collective efforts can create an understanding of urgency and raise perception about individual adaptation actions. These findings are consistent with previous research by Kahsay *et al.*, (2022), who argued that cooperative membership enhances access to information and resources, thereby improving farmers' perceptions of climate change strategies. This indicates the important role cooperatives play in fostering perception and understanding of climate change among farmers.

4.4.2 Insignificant variables

The binary logistic regression model results demonstrate that various explanatory variables were found to have no significant influence on small-scale maize farmers' perceptions on the application of climate change adaptation strategies. These insignificant variables include age, gender, household size, education level, farmer income, access to extension services, farm size in hectares, agricultural training, farming experience, and climate change awareness. Although these variables were not statistically significant, that does not make them irrelevant. Rather, this study provides little evidence to substantiate their impact on farmers' perception on the application of climate change adaptation strategies in Ward 27 of the Greater Giyani Local Municipality.

The lack of statistical significance for certain variables in the study does not imply they are irrelevant. According to the literature, variables like education and access to extension services can raise awareness and understanding of climate change but may not result in rapid changes in perception or behaviour. Instead, they act as underlying factors that can influence long-term adaptive ability (Anum *et al.* 2022). The complexity of farmers' decision-making processes often means that perceived risks do not always translate into action. For example, even when farmers recognize climatic changes, socio-economic barriers such as financial constraints or lack of market access can prevent them from implementing adaptive strategies (Addis and Abirdew, 2021).

4.5 Chapter Summary

This chapter provided an overview of the socioeconomic characteristics of small-scale maize farmers in Ward 27 of the Greater Giyani Local Municipality, utilizing descriptive statistics. It also interpreted the socioeconomic factors that shape these farmers' perceptions regarding the implementation of climate change adaptation strategies. To investigate these influencing factors, a Binary logistic regression model was employed, with the dependent variable being the farmers' perceptions of climate change adaptation strategies. The chapter thoroughly examined the adaptation strategies adopted by small-scale maize farmers in the study area and discussed their implications. A Likert scale was used to assess the perceptions of small-scale maize farmers concerning climate change adaptation strategies, and statistical tests confirmed that the model fit the data well, showing no signs of multicollinearity or heteroscedasticity. Key variables identified during the analysis included marital status, employment status, access to weather forecast information, and participation in farmers' cooperatives. These factors significantly influence farmers' perceptions regarding the application of climate change adaptation strategies. The conclusions drawn from these empirical findings, along with their policy implications, will be addressed in the subsequent chapter.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the study's main findings, discusses them, and draws conclusions based on descriptive and empirical analysis. This chapter also provides recommendations in the context of the results of the research.

5.2 Summary

The research was carried out in ward 27 of the Greater Giyani Local Municipality, classified as a Category B municipality within Limpopo Province's Mopani District. Primary data collection involved administering structured questionnaires through face-to-face interviews, during which 130 small-scale maize farmers were selected and interviewed. The questionnaires were developed based on insights from previous studies, and a snowball sampling technique was employed for participant selection.

To address the study's first objective, descriptive statistics, including cross-tabulations and frequency distributions, were utilized to profile the socioeconomic characteristics of the small-scale maize farmers. To assess their perceptions regarding the implementation of climate change adaptation strategies, responses from a Likert scale were analyzed using descriptive statistics. Finally, a Binary logistic regression model was applied to identify the socioeconomic factors that influence small-scale maize farmers' perceptions of climate change adaptation strategies.

The study revealed important demographic and economic information. The findings show a significant gender discrepancy, with female farmers comprising the vast majority (61%). This finding emphasises the substantial role women play in maize farming in the study area, contradicting the widely held belief that men dominate the agricultural sector. In terms of educational accomplishment, more than 50% of the small-scale had both secondary and tertiary education. Access to extension services is very limited, with 63.1% of small-scale farmers without access and 36.9% having it. This lack of access to extension services may jeopardise small-scale farmers' capacity to get critical information and support on climate adaptation methods. Regarding employment status, about 74.4% of small-scale maize farmers were unemployed and relied only on farming for a living. This high level of dependency on farming

emphasises the financial restrictions faced by most farmers, which can impair their ability to invest in vital farm inputs and adaptation strategies.

The findings revealed that approximately 63.8% of small-scale farmers had over five years of maize production experience, while 16.2% had 4 to 5 years, 13.8% had 2 to 3 years, and 6.2% had less than two years. The average age of the small-scale maize farmers was 57 years, with ages ranging from 23 to 85 years. This broad age range represents a diverse farming community, including both younger and older individuals, which may impact the adoption of new technology and strategies. Household sizes among small-scale maize farmers ranged from 1 to 10 members, with an average of 5 members.

The Likert-scale and descriptive statistics were employed to evaluate the small-scale maize farmers' perceptions on the application of climate change adaptation strategies. The findings reveal that 55.1 % of the small-scale maize farmers in the study area had positive perceptions on the application of climate change adaptation strategies, while 33.2% had negative perceptions. Additionally, 11.7 % of the small-scale farmers were uncertain about the effectiveness or practically implementing the adaptation strategies. This shows that most of the small-scale farmers in the study area are open to or supportive of adaptation strategies, though a significant portion remains either skeptical or unsure.

The empirical results of the Binary Logistic Regression model revealed that various variables significantly influenced small-scale maize farmers' perceptions of climate change adaptation strategies in ward 27 of Greater Giyani Local Municipality. These significant variables included marital status, employment status, access to weather forecasts information, and access to farmer cooperatives.

5.3 Conclusion

The study was aimed to explore small-scale maize farmer's perception on the application of climate change adaptation strategies in ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa. The hypotheses of the study were divided into two. This includes hypothesis one which posited that the small-scale maize farmers have a negative perception towards the application of climate smart approach and hypothesis two which stated that socio-economic characteristics do not

influence the perception of small-scale maize farmers on the application of climate change adaptation strategies in ward 27 of the Greater Giyani Local Municipality, Limpopo Province. The study rejects the null hypothesis, which states that small-scale maize farmers had a negative perception towards the application of climate smart approach, this is because of the findings of the likert scale which indicated that majority of the small-scale maize farmers had positive perceptions on the application of climate change adaptation strategies. Furthermore, the study rejects the second null hypothesis, which contends that socio-economic characteristics do not influence the perception of small-scale maize farmers on the application of climate change adaptation strategies, this conclusion was made because of the findings of the socio-economic characteristics of the small-scale farmers which indicated that the socio-economic characteristics of the small-scale farmers influence their perception on the application of climate change adaptation strategies.

5.4 Recommendations

To improve the perceptions and implementation of climate change adaptation strategies among small-scale maize farmers in Ward 27 of the Greater Giyani Local Municipality, various recommendations were made based on the study's findings.

5.4.1 Improving access to weather forecast information

The results showed that access to weather forecasts is statistically significant at the 1% level ($p = 0.005$) and has a positive coefficient ($B = 3.092$), indicating that having access to weather forecasts increases the likelihood of holding a positive view towards climate change adaptation strategies. Therefore, the government should enhance the dissemination of accurate and timely weather forecast information through local agricultural extension services and mobile technology. Creating partnerships with meteorological agencies can ensure that small-scale farmers receive relevant data that can inform their farming decisions. This recommendation supports the objectives of the National Climate Change Adaptation Strategy (NCCAS), which highlights the need for improved access to climate information as a key component of effective adaptation planning (Department of Environment, Forestry and Fisheries, 2019).

To implement this effectively, the Department of Environment, Forestry and Fisheries should lead in policy formulation and resource allocation, while the Department of Agriculture, Land Reform and Rural Development should collaborate in integrating

weather forecasts into agricultural extension services. The South African Weather Service should provide accurate and timely weather forecasts. Additionally, NGOs like Weather Impact and Kukua can assist in developing and disseminating tailored climate information services to small-scale farmers. By equipping farmers with reliable weather forecasts, they can make informed decisions about planting and harvesting times, thus reducing vulnerability to climate variability and improving overall productivity.

5.4.2 Enhancing employment opportunities for small-scale farmers

The results showed that the employment status of small-scale maize farmers is statistically significant at the 5% level ($p = 0.017$), with a negative coefficient ($B = -2.364$), suggesting that being employed reduces farmers' likelihood to perceive the application of climate change adaptation strategies. To address this, the government should prioritize initiatives that promote self-employment among small-scale farmers by investing in entrepreneurship and enhancing farm operations and productivity. This approach aligns with the objectives of South Africa's National Development Plan (NDP), which aims to create jobs, reduce poverty, and promote sustainable livelihoods (National Planning Commission, 2012). To implement this effectively, the Department of Agriculture, Land Reform and Rural Development should lead in policy formulation and resource allocation, while the Department of Small Business Development supports entrepreneurship initiatives.

The Agricultural Research Council (ARC) and the National Agricultural Marketing Council (NAMC) can assist in providing training programs focused on sustainable agricultural techniques and market access. Additionally, NGOs like Techno Serve and African Farmers Association of South Africa (AFASA) can support farmers in accessing financial resources and market opportunities, as well as promoting value-added activities. By fostering a culture of self-employment, these efforts can enhance farmers' income levels, encourage innovation in agricultural practices, and contribute to a more resilient agricultural sector capable of adapting to climate change challenges. Engaging employed farmers, who currently have lower perceptions of adaptation strategies, requires a strategic approach. Interventions should focus on enhancing their capacity to adopt climate change adaptation strategies without compromising their employment. This can be achieved by offering flexible training

programs that accommodate their schedules and collaborating with employers to provide incentives for employee participation in farming activities.

5.4.3 Strengthening access to farmers cooperatives

The results showed that access to farmer cooperatives is statistically significant at the 5% level ($p = 0.03$) with a positive coefficient ($B = 1.452$), suggesting that membership in cooperatives enhances small-scale maize farmers' positive perceptions towards climate change adaptation strategies. To capitalize on this, the government should encourage the formation and strengthening of agricultural cooperatives to support collective bargaining, resource sharing, and market access. This aligns with the goals outlined in the Climate Change Bill (2024), which aims to improve food security and promote sustainable farming practices through cooperative development (Department of Environment, Forestry and Fisheries, 2024).

To sustain cooperatives financially and technically, the government can employ several mechanisms. Financially, government subsidies can be provided by the Department of Agriculture, Land Reform and Rural Development to support cooperative development, focusing on infrastructure and operational costs. Additionally, microfinance initiatives through organizations like Micro Agricultural Financial Institutions of South Africa (MAFISA) can offer loans with favourable interest rates and repayment terms. Blended financing options, such as those offered by the Co-operative Development Support Programme (CDSP), can also be utilized, combining grants and loans to eligible cooperatives. Technically, the Agricultural Research Council (ARC) can provide training on sustainable agricultural techniques and climate-smart practices, while the National Agricultural Marketing Council (NAMC) can assist cooperatives in accessing markets and negotiating better prices for their products. By fostering cooperative structures, small-scale farmers can leverage collective resources to adopt climate-smart practices more effectively, contributing to national goals of food security and resilience against climate change.

5.5 Limitations and area of further study

This study examined the factors that influence small-scale maize farmers' perceptions on the application of climate change adaptation strategies in Ward 27 of the Greater Giyani Local Municipality, Limpopo Province, South Africa. While the study provides valuable insights into this specific context, it is important to acknowledge limitations that influence the generalizability and scope of the findings. Firstly, the focus on a single ward limits the applicability of the results to other regions of South Africa, which exhibit diverse climatic conditions, farming practices, and socioeconomic contexts. As highlighted in the literature, maize production and vulnerability to climate change vary significantly across provinces (Baloyi, 2011; Gbetibouo *et al.* 2010), emphasizing the need for broader investigations.

Therefore, future research could expand to other wards, districts, and provinces to provide a more comprehensive understanding of the factors influencing farmers' perceptions and adaptation strategies across the country. Furthermore, while this study focused on farmers' perceptions, research could investigate the actual implementation and effectiveness of various climate change adaptation strategies, as well as exploring other adaptation and mitigation strategies beyond those covered in this study, potentially incorporating indigenous knowledge and practices (Fosu-Mensah *et al.* 2012).

Finally, future studies should prioritize the examination of socioeconomic factors, such as gender, age, education, access to credit and extension services, and land tenure, on farmers' perceptions, adaptive capacity, and adoption of these strategies. Understanding how these factors shape farmers' responses to climate change will be crucial for developing effective, targeted policies and interventions that support sustainable maize production and improve the livelihoods of small-scale farmers in South Africa.

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APPENDIX A: Acceptance letter for Publication



Company Registration Number: 201899999G

Acceptance Letter

Dear Author(s): N.D. Mkansi, L.J. Ledwaba and J.P. Mokhaukhau,

We are pleased to inform you that your article entitled "*Smallholder farmers' perceptions of climate change adaptation strategies. The case of the Greater Giyani Local Municipality, Limpopo Province*" (Article ID 1287) has been accepted for publication in *Research on World Agricultural Economy* (ISSN/E-ISSN: 2737-4777/2737-4785) after successfully passing the peer-review process and revisions made by the authors. It will be further processed for publication.

Thank you for your excellent contribution to our journal.

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ARTICLE

Smallholder Farmers' Perceptions of Climate Change Adaptation Strategies: The Case of the Greater Giyani Local Municipality, Limpopo Province

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ABSTRACT

Small-scale farmers' perceptions of climate change adaptation strategies are crucial for enhancing agricultural resilience and sustainability. Just like in most countries, the agricultural industry in South Africa has adopted several strategies aimed at mitigating challenges linked to climate change, which poses a significant threat to agricultural production, water resources, food security, and ecosystem health. Consequently, this study aimed to explore small-scale maize farmers' perceptions on the application of climate change adaptation strategies in Greater Giyani Local Municipality, Limpopo Province, South Africa. A sample of 130 small-scale maize farmers was selected using snowball and purposive sampling techniques. Descriptive statistics, including cross-tabulations and frequency distributions, were utilized to profile the socio-economic characteristics of the farmers, addressing the study's first objective. The binary logistic regression model was used to analyse the factors influencing small-scale maize farmers' perceptions on the application of climate change adaptation strategies. The empirical results revealed several variables that significantly influenced small-scale maize farmers' perceptions on the application of climate change adaptation strategies. These included marital status, employment status, access to weather forecasts and participation in farmer cooperatives. The study recommended targeted support for smallholder farmers in the study area to improve their knowledge of climate change adaptation strategies, including flexible training programs and

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incentives. Enhancing access to weather forecasts, strengthening farmer cooperatives, and promoting experiential learning are also crucial.

Keywords: Climate Change; Perception; Adaptation Strategies; Small-Scale Maize Farmers

APPENDIX B: Consent form



CONSENT FORM TO PARTICIPATE IN RESEARCH

RESEARCH TOPIC: FARMER'S PERCEPTIONS ON THE APPLICATION OF CLIMATE CHANGE ADAPTATION STRATEGIES: A CASE STUDY OF SMALL-SCALE MAIZE FARMERS IN WARD 27 OF THE GREATER GIYANI MUNICIPALITY, LIMPOPO, SOUTH AFRICA

Dear Participant.

You are requested to participate in the above-mentioned research study by Mkansi Ntlharihani Deon (Department of Agricultural Economics and Animal Production, University of Limpopo). You were selected to take part and participate in this study as you are small-scale maize farmers within Ward 27 of the Greater Giyani Local Municipality.

1. Aim of the study

To document small-scale maize farmers perception on the application of climate change adaptation strategies and factors influencing their perception.

2. Participation

Kindly take note that participation will be voluntarily. Each participant will be asked to give their consent to proceed with the study and respondents can withdraw from the study at any time without any penalty. You can also refuse to answer questions you don't want to answer and still remain in the study. The investigator/researcher may withdraw you from the study if there are circumstances which warrant doing so.

3. Confidentiality

The information provided in this study will be treated with confidentiality and will be disclosed only with your permission. The information gathered by the researcher shall be used solely for the purpose of this research only. No personal information of respondents and details will be used in this study and no mention of names shall be indicated in the study.

4. Potential benefits to subjects/ society

The findings will contribute to policy and practice interventions that enhance the resilience of small-scale maize farmers to climate change impacts. By understanding and addressing farmers' perspectives, effective and targeted interventions can be developed to support their adaptation efforts and ensure the long-term sustainability of agriculture in the face of climate change.

Should you have any questions or concerns about your participation in the study please contact:

Mr ND Mkansi on this email deonmkansi92@gmail.com or Dr LJ Ledwaba, Department of Agricultural Economics and Animal Production, University of Limpopo, Tel: 015 268 2350; Email: Lesetja.ledwaba@ul.ac.za

Do you voluntarily agree to participate in this interview? **Yes, or no? If yes, please fill in your details below.**

Name of participant:
Date	:
Municipality	:
Trading area	:
Contact details	:

APPENDIX C: Questionnaire

QUESTIONNAIRE

FACULTY OF SCIENCE AND AGRICULTURE
SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF AGRICULTURAL ECONOMICS AND ANIMAL PRODUCTION
UNIVERSITY OF LIMPOPO, SOUTH AFRICA

Questionnaire survey

By

Mkansi Ntlharihani Deon

Ethical statement: The study will abide by ethical standards – stipulated by the University of Limpopo such as respecting the dignity of respondents, ensuring the protection of the privacy of the small-scale farmer, ensuring that participants participate voluntarily, and acknowledging the works of other authors. Hence, information obtained from participants will be kept in strict confidentiality, and respondents will not be forced to take part in the study.

This questionnaire is meant for the on-going research project titled "Farmer's perceptions on the application of climate change adaptation strategies: a case study of small-scale maize farmers in ward 27 of the Greater Giyani Municipality, Limpopo, South Africa". The aim of the study is to generate knowledge on farmer's perceptions on the application of climate change adaptation strategies in Greater Giyani municipality, Limpopo, South Africa.

Questionnaire number	
Name of respondent	
Contact of respondent	
Date of interview	
Village name	

Instructions: Kindly put a cross (X) or fill in the space; and answer the questions as honestly as possible.

FARMER'S PERCEPTIONS ON THE APPLICATION OF CLIMATE CHANGE ADAPTATION STRATEGIES: A CASE STUDY OF SMALL-SCALE MAIZE FARMERS IN WARD 27 OF THE GREATER GIYANI MUNICIPALITY, LIMPOPO, SOUTH AFRICA

This questionnaire serves to gather information on the socio-economic characteristics of small-scale crop farmers in Greater Giyani municipality, Limpopo, South Africa, to determine the farmers perception on the application of climate change adaptation strategies in Greater Giyani municipality, Limpopo, South Africa and determine factors influencing the farmers perception on the application of climate change adaptation strategies in Greater Giyani municipality, Limpopo, South Africa.

SECTION A: Farmers Socio-economic characteristics

1. What is your age?

--

2. what is your gender?

1	2
Female	Male

3. What is your marital status?

1	2	3	4
Single	Married	Divorced	Widowed

4. What is the size of your household, i.e., how many are you in the household?

5. What is your employment status

1. Unemployed	
2. Employed	

6. what is your highest level of education

1. No formal education	
1. Primary level	
2. Secondary level	
3. Tertiary level	

7. How much household income do you receive monthly?

--

8. Do you have other sources of income?

1	2
Yes	No

SECTION B: Farmers' response to the factors influencing the perception on the application of climate change adaptation strategies.

9. Do you have access of extension services ?

1. Yes	
2. No	

10. What is the size of your farm i.e., hectares ?

11. Do you have access to credit ?

1. Yes	
2. No	

12. Do you receive any agricultural training related to climate change and adaptation strategies?

1. Yes	
2. No	

13. For how many years have been involved in crop production?

<2 years	2-3 years	4-5 years	5-6 years	>6 years

14. Are you aware of climate change?

1. Yes	
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2. No	
-------	--

15. What adaptation strategies are you using to manage climate change in your farm? (Hint: crop diversification, drought resistance seeds, planting time, water management and improved irrigation practices)

16. Do you have access on information of weather forecast?

1. Yes	
2. No	

17. Are you in farmers' cooperative groups/ association?

1. Yes	
2. No	

SECTION C: The farmers perception on the application of climate change adaptation strategies.

N: B Strongly agree (SA)=1, Agree(A)=2, Uncertain(U)=3, Disagree(D)=4 and strongly disagree (SD)=5

	Rating				
	SA	A	U	D	SD
1. I believe that climate change adaptation strategies are necessary for long -term sustainability of my farm					
2. I am willing to adopt and implement climate change adaptation strategies on my farm					
3. I feel knowledgeable about the different climate change adaptation strategies that can be applied on my farm					
4. I perceive climate change adaptation strategies to be effective in mitigating the impact of climate change on my farm					
5. I believe that climate change adaptation strategies are practical and feasible to implement on my farm					

APPENDIX D: Ethical clearance certificate



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TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 31 October 2023

PROJECT NUMBER: TREC/1636/2023: PG

PROJECT:

Title: Farmer's perceptions on the application of climate change adaptation strategies: A case study of small-scale maize farmers in ward 27 of the Greater Giyani municipality, Limpopo, South Africa.
Researcher: ND Mkansi
Supervisor: DR LJ Ledwaba
Co-Supervisor: Dr J P Mokhaukhau
School: Agricultural and Environmental Sciences
Degree: Master of Science in Agricultural Economics


PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: REC-0310111-031

Note:

- i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
- ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
- iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.