Assessment of the Effectiveness of Agricultural Extension Services in Enhancing Food Security among Smallholder Maize Farmers in Makhado Local Municipality, Limpopo Province, South Africa

By

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A Dissertation Submitted for the

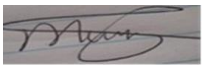
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ABSTRACT

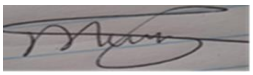
Food security is a pressing concern not only in South Africa, but globally. According to the National Food Security indicators, South Africa is food secure nationally, but the same cannot be said at the household level. Meanwhile, agricultural extension services (AES) play a crucial role in supporting smallholder farmers through the provision of usable information, which can enhance food production and ultimately improve food security. The services rendered by extension workers provide farmers with the knowledge, skills, and resources necessary to improve their agricultural practices and increase productivity. The study was conducted in the Makhado Local Municipality, of Limpopo province, South Africa. It involved collecting data from a random sample of 250 smallholder maize farmers which was subsequently analyzed using descriptive statistics, Freer Greer Thorbecke (FGT) index of poverty measures, and Probit model. The results show that most respondents were male (53.6%) and aged above 60 (60.0%). A sizeable number of the respondents were educated, with 50.8% having secondary education. The study highlights the significant role of AES in improving food security, with 74.8% of respondents indicating enhancement of AES as a measure to improve food security. In achieving sustainable food security, structural barriers such as inadequate land access, water scarcity, and limited training opportunities were also identified as critical constraints. Probit model results indicate that, with a coefficient of age and access to credit, it was statistically significant at the 5% significant level, and they had a negative relationship with food security status. Moreover, the study also uncovered that effective extension services and access to the market had a negative relationship with food security status, and they were significant at a 1% level. The income level and land size were statistically significant at 5% but positively related to food security status. The study, therefore, recommends strengthening AES, improving market access, and increasing access to credit for smallholder farmers. Thus, tackling food insecurity requires a comprehensive strategy that considers the interplay of demographic, economic, and institutional factors.

Keywords: Agricultural extension, Effectiveness, Extension, Food security, Household, Household food security, Smallholder farmers.

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DECLARATION

I, Trevor Munyai, student number 18019814, declare that this dissertation, Assessment of the Effectiveness of AES in Enhancing Food Security among Smallholder Maize Farmers in Makhado Local Municipality, Limpopo Province, South Africa, is my work and has not been submitted for any degree in this or at any other institution. All essential and auxiliary sources have been fittingly recognized and duly acknowledged.

Signature:  **Date: 18/08/2025**

Ms. T Munyai

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DEDICATION

I would like to dedicate this work to the Almighty God, who loved me and showed me grace throughout the process. I also dedicate it to my parents, Munyai Simon Ntanganedzeni and Singo Bridget Vhulahani, who allowed me to make my own choices and believed in me. Their influence continues to shape my work and drive my passion for knowledge. I am grateful for their guidance.

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- I also wish to thank the extension practitioners for the positive response during my inquiry and for helping me to reach out to smallholder maize farmers.
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ACRONYMS

AES	Agricultural Extension Services
DALRRD:	Department of Agricultural Land Reform and Rural Development
FPL:	Food Poverty Line
FGT:	Foster Greer Thorbecke Model
LBPL:	Lower Food Poverty Line
SPSS:	Statistical Package for Social Sciences
UBPL:	Upper Food Poverty Line

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CHAPTER ONE
INTRODUCTION

1.1. Background

Ensuring food security and increasing food availability are key objectives for the agriculture sector (Wegren & Elvestad, 2018). Despite concerted efforts to alleviate global hunger, food insecurity and under nutrition persist as significant challenges worldwide (Sibhatu & Qaim, 2017). Rising food prices and income inequality, driven by increasing demand and declining agricultural productivity, threaten the food availability and access of low-income households. The primary drivers of hunger and malnutrition are poverty, natural disasters, climate change, and population growth (Prosekov & Ivanova, 2018).

According to the Food Africa Organisation (FAO) of the United Nations (UN) (2020), approximately 13% of individuals in developing countries face malnutrition. As noted by Porkka et al. (2013), the global food challenge is likely to intensify in the future. To address this issue, efforts aim to enhance food security and alleviate poverty by empowering smallholder farmers at the household level in rural areas, where agriculture serves as the primary economic driver (Villabona, 2018). Smallholder farmers are important to the agriculture sector because they grow most of the food in these areas. Due to their limited resources, multiple individuals in South Africa now mostly rely on these farmers for their food supply, and this trend will probably continue for some time. Public extension services give farmers the crucial agricultural support they need. This is essential for smallholder farmers who find it difficult to access private extension services because of resource limitations (Raidimi and Kabiti, 2017).

Food security in South Africa can be evaluated at both household and national levels (Ogunniyi et al., 2019). While national indicators suggest that South Africa has achieved food security, many households still struggle with food insecurity despite the country's sufficient food production (Ogunniyi et al., 2019). Food security is achieved when individuals have access to sufficient, nutritious food to maintain a healthy lifestyle, facilitated by social, physical, and financial resources (Ogunniyi et al., 2019). However,

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global food security is threatened by various factors, including limited food access, political instability, pests, diseases, and climate change (Leisner, 2020).

Agricultural extension agents are change agents who support and motivate farmers to apply new technological advancements that are more targeted and effective in enhancing agriculture through modifying the farmers and offering the farmers market (Woldemariam, 2021 and Dlaz, 2021). The goal of Agricultural Extension is to change how farmers think and act so they may participate actively in programs for agricultural development and breakthrough social barriers to increase farm productivity (Blanco, 2020). Various agricultural reforms have been undertaken by numerous developing countries, with differing degrees of success. Because it gives farmers access to informal education, agricultural extension is essential to expanding the agricultural sector (Souza, 2020). Therefore, agricultural extension works with farmers and the next generation as a trainer, educator, communicator, and distributor of technology and knowledge (Lima, 2020).

For farmers in developing countries with limited literacy and access to information and Communication Technology (ICT), Agricultural Extension Services (AES) are a critical information source (World Bank, 2017). These services provide farmers with essential knowledge on various topics, including cultivation techniques, fertilization, pest control, marketing, and climate change adaptation (Berhane et al., 2018). Given the significant benefits of agricultural extension, access to government-funded extension services is vital for many farmers who cannot afford private services. Consequently, governments in most developing countries are the primary providers of extension services.

One of the main goals of the government's extensive extension service provision is to ensure farmers get necessary support to produce enough high-quality produce, ensuring the nation's food security (Akram, 2012). As a result, efficient extension services are essential to a nation's food security and agricultural sustainability (Talib et al., 2018). The communication channels used in extension are essential as they guarantee accuracy of indicators and the productivity of extension initiatives (Haq, 2020). The application of information received, shifts in attitudes and thought processes, and farmers' ability to disseminate knowledge within their community all indicate how well extension

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communication works (Acevedo-Osorio, 2020). The attitudes of farmers are shaped by their experiences and education through direct handling, social learning, and classical conditioning (Somanje, Mohan & Saito, 2021).

Agricultural Extension Services (AES) employ various delivery strategies, including farmer training, on-farm visits, demonstrations, seminars, and open discussions, which also serve as evaluation tools for their effectiveness (Maoba, 2016). The adequacy of extension services can be assessed by evaluating how well extension staff provides orientation, utilizes media, offers scientific guidance, and motivates farmers (Ramesh, Govind & Vengatesan, 2019). The primary objectives of AES are to enhance food security and support smallholder maize producers (Villabona, 2018). These services aim to equip farmers with the necessary knowledge, resources, and equipment to improve their agricultural practices and increase productivity (Msuya et al., 2017). Smallholder corn farmers that use agricultural extension receive farming techniques to increase yield. Since maize is a staple food, it significantly lowers poverty and enhances food security for low-income families (Zuma, Kolanisi, & Modi, 2018).

1.2. Statement of the research problem

Despite efforts to address food insecurity, a significant proportion of South African households continue to face hunger and inadequate food access, with approximately 1.6 million households experiencing hunger and 13.4 million households struggling to access sufficient food in 2017 (Statistics South Africa, 2019), highlighting a critical need to investigate and address the underlying causes of food insecurity in South Africa. This suggests that addressing food poverty at the home level is necessary. This is important information because it suggests that the economy faces a significant challenge in reducing poverty, given the lack of access to food supply. According to Chakona and Shackleton (2019), the South African economy saw a 1.4% annual population growth in 2018. The population is growing, and this is particularly important if food shortages affect households. The nation's poverty and food insecurity have been addressed by the government using a variety of strategies. These methods have not, however, yet produced fruitful outcomes. Providing agricultural public goods and services at all levels is entrusted to South Africa's public sector research and extension services.

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Agricultural Extension Services (AES) must demonstrate high quality, relevant and must enhance agricultural productivity to be deemed adequate by farmers. Effective extension services play an important role in a country's agricultural sustainability and food security (Talib, 2018). Farmers must enhance agricultural productivity for AES to be deemed effective by farmers (Somanje, Mohan & Saito, 2021). Despite being a food-secure nation, many South African households nevertheless experience food insecurity (Statistics South Africa, 2019). Food insecurity threatens survival since the money needed to buy food is often derived from the households' social grant income (David & Grobler, 2020). Although enough food is produced in South Africa to feed its people, many households worry about food insecurity (Statistics South Africa, 2019). According to Statistics South Africa (2019), this situation is linked to the nation's high rates of poverty, which are especially prevalent in rural areas. It is estimated that almost 63 percent of the population is living below the upper-middle income poverty line, around 1.8 million more poor people relative to the pre-pandemic period (South African World Bank, 2023). It is generally agreed upon that establishing household food security is a critical first step toward raising the standard of living for the poor in rural areas.

Despite ongoing agricultural extension efforts in South Africa, smallholder farmers continue to face significant gaps in productivity and profitability (Bjorn Meier, 2017). A major contributor to this issue is the lack of knowledge, expertise, and resources, hindering the adoption of modern technologies and best practices (Fanzo, 2017). Furthermore, the effective packaging and dissemination of knowledge and training materials to farmers, extension workers, and other stakeholders have been neglected (Bjorn Meier, 2017). To bridge this knowledge gap, it is essential that South Africa's extension system enhances its development communication strategies (Haq, 2020).

Smallholder maize farmers that use agricultural extension receive farming techniques to increase yield. Since maize is a staple food, it significantly contributes to lowering poverty and enhancing food security for low-income families (DAFF, 2020). According to the State of Food Security and Nutrition in the World report (2024), in many nations, like South Africa where many households struggle to obtain wholesome food, food security has been a major concern. The report stated that approximately 28.9% of the world's population

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(2.33 billion people) experienced moderate to severe food insecurity, meaning they did not always have access to enough food. Statistics South Africa (2021) report showed that fourteen million South Africans, experienced daily hunger. Food and nutrition issues, like as hunger, micronutrient deficiencies, stunting, wasting, and obesity, continue to affect the people of South Africa. Despite the fact that South Africa produces enough food domestically and imports enough to feed everyone, many families and individuals go to bed hungry (Stats SA, 2022). With a projected 1 in 5 South African homes lacking enough food to eat, this situation is only getting worse (Wits, 2023). This implies that household-level measures to combat food poverty are required.

Millions of South Africans rely on maize as their primary food supply, making it one of th e most significant crops in the country (DAFF, 2020).The majority of South Africa's maiz e crop is consumed by humans. Farmers must increase agricultural output for agricultural extension services to be considered effective (Somanje, Mohan and Saito, 2021). Yet, there is a lack of comprehensive studies assessing the effectiveness of these services in the specific context of smallholder maize farming in Makhado Local Municipality. Such research is critical to identifying gaps and opportunities for improvement, ultimately contributing to sustainable food security, poverty reduction, and economic development in this region. Therefore, this study is essential to inform evidence-based policies and interventions that can enhance the livelihoods of smallholder maize farmers and bolster food security in Makhado Local Municipality and beyond. Therefore, the study examined the effectiveness of agricultural extension services in enhancing food security among smallholder maize farmers in Makhado local municipality of the Limpopo province in South Africa.

1.3. Justification of the study

Maize is a crucial crop in South Africa's economy, and smallholder farmers in the Vhembe district municipality play a vital role in ensuring regional food security (Zuma, Kolanisi & Modi, 2018; Economics, 2021). However, food insecurity persists due to climate change, limited resources, and low productivity (Jin & Huffman, 2016). Agricultural Extension Service (AES) aim to address these challenges by providing farmers with essential knowledge and support (Baloch & Thapa, 2018). Nevertheless, there is a notable gap in

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research assessing the effectiveness of these services in supporting smallholder maize farmers in Makhado Local Municipality. This study seeks to fill this knowledge gap, informing data-driven policies and interventions that can improve the livelihoods of smallholder maize farmers, enhance food security, and contribute to poverty reduction and economic growth in the region. Specifically, this research aimed to evaluate the impact of AES on food security among smallholder maize farmers in the Vhembe District Municipality of South Africa's Limpopo Province.

1.4. Objectives and research questions

1.4.1 Main objective of the study

The main aim of this study was to assess the effectiveness of AES in enhancing food security among smallholder maize farmers in the Makhado local Municipality of Limpopo Province, South Africa.

1.4.2 Research objectives

The specific research objectives were to

a) Identify and describe the socioeconomic characteristics of smallholder maize farmers in the Makhado local municipality of Limpopo province, South Africa;

b) Identify different services rendered by extension officers and their effectiveness;

c) Determine the food security status of smallholder maize farmers in the study area; and

d) Examine the relationship between food security and the effectiveness of AES in the study area.

1.4.3 Research questions

a) What are the socioeconomic characteristics of smallholder maize farmers in the Makhado Local Municipality of Limpopo Province, South Africa?

b) What are the different services rendered by agricultural extension officers and how effective are the services?

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c) What is the food security status of smallholder maize farmers in the study area?

d) What is the relationship between food security and the effectiveness of AES?

1.5. Operational definitions of the key terms and concepts

1.5.1. Food security- is people's ability to physically, socially, and economically obtain enough food that meets their nutritional needs regularly, as well as their willingness to lead healthy lifestyles (Penner, Kevany & Longboat, 2019). According to the FAO (2017), food security is attained when every individual has consistent access to sufficient, safe, and nutritious food that meets their dietary needs, supports their overall health, and reflects their food preferences and cultural values.

1.5.2. Agricultural extensions- function as catalysts for change, supporting and helping farmers to apply innovative technological advancements that are more targeted and intelligent in expanding agriculture through adjustments to the farmers and provide farmers with markets (Woldemariam, 2021 and Dlaz, 2021).

1.5.3. Extension- a cooperative process that requires communication between the trainer and the extension worker to create a "behavior" change process incorporating skills, knowledge, and attitudes (Seleiman, 2020).

1.5.4. Household- Any group of people residing in a home as a family or collection (Didiza, 2006).

1.5.5. Household food security- is the quantity of food a household can access to meet its daily needs (Bese, 2010). The ability to purchase enough high-quality food to meet each household member's nutritional needs is called household food security, and it mostly depends on their purchasing power and level of economic freedom (Endalew, Muche & Tadesse, 2015).

1.5.6. Farmer: Any individual working in agriculture and rearing animals for sustenance or raw resources (SOFA, 2017).

1.5.7. Effectiveness: the extent to which an effort succeeds in yielding the intended outcome; achievement. It is the capacity to generate the intended outcome or the ability to produce the desired result (Dictionary, 2011).

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1.5.8. Smallholder farmers have been awarded small-base plots of land, which they use to cultivating the cash crops and subsistence crops, nearly entirely dependent on agricultural labor (DAFF, 2012). Farmers frequently connected to maize production will be referred to as smallholder farmers or small-scale farmers (Mdlalose, 2016).

1.6. Organisation of the dissertation

This dissertation consists of five chapters. Chapter two provides the role of AES in agricultural development and food security, SA food security conditions, and smallholder farmer's food security status. Chapter three presents the methodology employed, including a description of the study, research design, sample size, population and sampling method, data collection method, method of data analysis, ethical considerations, limitation of the study, and expected outcomes. Chapter four provides the results and discussion of the results obtained from the respondents. Chapter five contains the summary of the findings, conclusion, recommendations, and future research gap. The next chapter present the literature review which explore role of AES in agricultural development and food security, SA food security conditions, and smallholder farmer's food security status

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CHAPTER TWO
LITERATURE REVIEW

2. INTRODUCTION

This chapter provides the theoretical framework of the study, the role of AES in agricultural development and food security, South Africa (SA) food security conditions, food security status of smallholder farmers, and Summary of the literature review

2.1. Theoretical framework of the study

The study's foundation in the theory of consumer behavior provides a valuable framework for understanding the decision-making processes of smallholder maize farmers. Examining how individuals make purchasing decisions based on personal preferences, income, and product costs, the study can gain insights into how farmers allocate their resources to maximize satisfaction. According to Liberto (2023), consumer behavior theory is essential in understanding how consumers make choices to achieve their objectives. In the context of smallholder maize farmers, this theory can help explain how farmers make decisions about the practice that they utilize, including the allocation of labor and resources. Perfect (2020) stated that consumer behavior focuses on how individuals try to satisfy their wants within their limited income, which is particularly relevant for smallholder farmers who often face significant resource constraints. When applying consumer behavior theory to smallholder maize farmers, the study can identify strategies to improve the effectiveness of Agricultural Extension Services (AES) in enhancing food security among these farmers.

The main objective of the study is to assess the effectiveness of AES in enhancing food security among smallholder maize farmers in the Makhado local Municipality of Limpopo Province, South Africa. This objective is critical in addressing the food security challenges faced by many smallholder farmers in the region. By evaluating the effectiveness of AES, the study can identify areas for improvement and provide recommendations for enhancing the impact of these services on food security. The study's focus on smallholder maize farmers in the Makhado local Municipality provides a specific context for understanding the challenges and opportunities faced by these farmers, and the findings can inform policies and programs aimed at improving food security in similar contexts. The objectives

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of farmers includes the desire to acquire money and satisfy their needs, provides a relevant perspective on the motivations and decision-making processes of smallholder maize farmers (Debertin, 2012). By understanding these motivations and decision-making processes, the study can develop targeted strategies to support smallholder farmers in achieving their objectives and improving their food security.

2.2. The role of AES in agricultural development and food security

Having agricultural and extension services in a country without either is unimaginable. In developing nations where agriculture serves as main income sources, the extension is becoming more essential for rural development (Temesgen & Tola, 2015). To boost productivity, improve rural livelihoods, increase food security, and position agriculture as a driver of pro-poor economic growth, it is important to implement agricultural extension and training ‘also referred to as advisory services’ (International Food Policy Research Institute (IFRI), 2015). Strong communication between service providers and farmers is necessary for the generation of new information (Laurent et al., 2006). To improve rural communities' productivity, income, and quality of life, agricultural extension, and training serve as systematic, participative means of delivering need- and demand-based information in agronomic techniques and skills. In essence, extension is training with the goal of changing farmers' behaviour for the better (IFPRI, 2015).

Agricultural extension is a voluntary, non-formal training program that aims to improve the status of agricultural workers in social, economic, and cultural spheres (Ate & Cakal, 2014). However, there are costs associated with agricultural extension for both farmers and service providers. To overcome the lack of funding and ensure the longterm provision of agricultural consulting services, many extension experts and policymakers support fee-based services (Uddin et al., 2014). Because they can increase yields, lower production costs, enhance incomes, and lessen poverty, agricultural extension programs have gained popularity as a kind of agricultural intervention in developing countries (Villabona, 2018). The role of agricultural extension is to support smallholder farmers in increasing their agricultural productivity, which is heavily dependent on their ability and willingness to innovate. Through increased access to knowledge and information, initiatives and consulting services seek to enhance agricultural collaboration (Harun, 2021).

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To create behavior change process encompassing knowledge, attitudes, and abilities, the extension worker and the trainer must work together in a collaborative process (Seleiman, 2020). Nascimento (2020) argues that behavioural science is the ground for extension and the scientific foundation of behavioural science. Extension activities are an on-going process that demands all of a person's might and cunning; they go beyond merely disseminating information or innovations, and providing information, to achieve a more comprehensive outcome. As change agents, agricultural extension workers support and encourage farmers to apply innovative technological advancements that are more targeted and complex in expanding agriculture through empowering transformations among farmers themselves, and providing them with market access and opportunities (Woldenmariam, 2021 and Dlaz, 2021).

Agricultural Extension aims to change farmers' habits so they may actively participate in programs for agricultural development and break down social barriers while boosting farm productivity (Blanco, 2020). Various agricultural reforms have been undertaken by numerous developing countries, with differing degrees of success. Souza (2020) asserts that because agricultural extension gives farmers access to informal education, it is essential to expand the agricultural sector. As highlighted by Maas (2020b), the adoption of modern agricultural technology is a crucial approach to sustainable agricultural development, yielding multiple benefits including enhanced productivity, improved farmer livelihoods, and increased market competitiveness. Additionally, this technology optimizes resource utilization, leading to more efficient and sustainable agricultural practices. Along the way, extension activities are characterized in a number of ways, such as information/dissemination, non-formal education, behaviour modification, social manipulation, technological and innovative social marketing, social transformation, empowering communities, and community strengthening (Moreno, 2021).

As they guarantee efficacy of predictors and the success of extension programs, the communication channels used in extension are essential (Haq, 2020). Cardoso (2020) states that the application of information received, shifts in attitudes and thought processes, and farmers' ability to disseminate knowledge within their community all indicate how effective extension communication is. The attitudes of farmers are shaped

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by the learning processes and experience like direct handling, social learning, and classical conditioning, claims Acevedo-Osorio (2020). Extension is more than just a means of sharing technology; it also entails various activities by extension workers to address farmer issues and target communities. This suggests that extension involves investigating the technology involved as well. According to Maas (2020a), extension is an adult education program where farmers engage in self-directed learning to gain the skills and technology required to resolve problems on their own.

Extension services give farmers and other agriculture-related professionals' access to up-to-date farming knowledge and education, enabling them to improve agricultural practices and develop technical skills. This extends beyond the technological aspects of agricultural methods. To interact in their individual markets more successfully, communicate with the right people in the right ways, and access better and more efficient marketplaces. Because current technology is used, the productivity of extension services is great (Mvvangi & Kariuki, 2015). These services tell farmers about the newest technologies so they can implement them and increase their profitability. Additionally, this raises people's standards of living (Nohmi, Elias, Ishida, & Yasunobu, 2018). A growing number of people are becoming aware of contemporary technology and incorporating it into their agricultural practices thanks to extension service providers. Demonstrating the usage process, they help ensure people fully comprehend how to use the new technology.

Adult farmers can also take advantage of extension services to obtain the necessary education and information about current agricultural methods. Farmers utilise this expertise to make better use of technology. In addition to using technology, they also propagate its use by telling others about it (Rehman et al., 2016). Extension service providers also recognize farmers' issues and work to address them immediately. They create specific communities that teach farmers the newest techniques for farming and provide them access to better markets, resulting in more significant income. To keep their technology current, technology developers receive input from extension service providers regarding the technology farmers utilise in their operations (Awotide, Karimov, & Diagne, 2016).

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Since the majority of people in less developed nations depend on agriculture as their primary means of income, agricultural development is crucial to eradicating poverty in these nations, where income is based on land and natural resources (Nugraha & Osman, 2017). Certain developed countries' international organizations create and supply technologies to less developed nations to increase productivity and profitability. Although most people employ extension services to address issues with low productivity, farmers' ignorance and illiteracy contribute to a lower adoption rate. Farmers can be reluctant to stray from their customs, which makes them uninterested in using contemporary technologies and extension services. Even extension service providers occasionally fail to assist farmers in learning about the newest technologies.

2.3. South Africa's food security condition

According to Statistics South Africa (2019), the country faced significant food insecurity challenges in 2017, with approximately 13.4 million households experiencing inadequate or severely inadequate access to food, while a further 1.6 million households suffered from hunger. This suggests that addressing food poverty at the home level is necessary. According to Chakona and Shackleton (2019) the South African economy saw 1.4% annual population growth in 2018. The population is growing, and this is particularly important if food shortages affect households. Numerous studies have focused on the endeavour to end hunger, food insecurity, and other types of malnutrition (Xie et al., 2021). However, many countries continue to struggle with severe food insecurity despite recent progress in these areas, especially developing nations like Sub-Saharan Africa (Xie et al., 2021 and Cheteni et al., 2020).

The global community first recognized the collective responsibility to address hunger and malnutrition in the 1970s, prompted by widespread food insecurity (Roman, 2003). Despite efforts to improve food access, per capita food consumption declined in the 48 least developed countries between 1980 and 1998, contrasting with increases in emerging nations (Vasileska & Rechkoska, 2012). The 1996 World Food Summit aimed to significantly reduce inadequate nutrition by 2015, but progress fell short, with only a projected 20 million fewer hungry people globally between 2000 and 2015 (Gentilini & Webb, 2008). Over the past three decades, global food production has outpaced

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population growth, but stable distribution networks remain crucial for food security. The COVID-19 pandemic has severely tested this stability, exposing the global food system to unprecedented economic threats, including lockdowns, recessions, trade restrictions, and soaring food costs (Erokhin & Gao, 2020). The pandemic, combined with the Ukraine conflict and food supply disruptions, has driven food prices to record highs, affecting vulnerable populations in low- and middle-income countries, where food expenditures account for a significant portion of household income (UNICEF, 2021).

Efforts to improve food supplies in Africa have been ongoing for years, yet food insecurity remains a persistent challenge. According to the Sub-Saharan African Food Security (SSAFB), approximately one-third of the region's population suffers from under nutrition (Fraval et al., 2019). This widespread under nutrition undermines Africa's potential for sustainable economic growth, as a malnourished and sick population hinders development. Despite international food aid, under nutrition persists in many African countries. The food security situation in Sub-Saharan Africa (SSA) is worsening due to factors such as changing consumer behaviors, rapid population growth, and global economic turmoil (Onwujekwe et al., 2021). The economic downturn in SSA has severely impacted rural communities, threatening livelihoods and exacerbating food insecurity. Since 2015, SSA has experienced a surge in food insecurity rates, jeopardizing progress toward the United Nations' Sustainable Development Goal (SDG) 2, which aims to achieve Zero Hunger by 2030.

Numerous studies have identified several numbers of factors that substantially contribute to food insecurity in Africa. Low agricultural productivity, low economic growth, gender inequality, food price inflation, drought, inadequate irrigation investment, climate change, and rapid population growth are a few examples (Campbell et al., 2016; Sirba & Chimdessa, 2021; Onwujekwe & Ezemba, 2021; Botreau & Cohen, 2020; Hossainet al., 2029). Climate-induced occurrences such as floods, extreme rains, droughts, cyclones, and storms have a negative impact on food security and rural income in developing countries with low income (Hossain et al., 2019; Zieba et al., 2020 and Kershaw et al., 2011). "Food security" refers to having enough food to lead an active and healthy lifestyle (Cafiero & Viviani, 2018). One of the most important aspects of well-being is food security,

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or the ability of households and individuals to receive food, yet measuring it is not without its challenges. Global food security still depends on ensuring everyone has access to enough food, whatever its complexity.

The seasonal and annual fluctuations in temperature and rainfall that sub-Saharan African nations, including South Africa, have experienced recently have had a number of negative impacts on sustainability of the agricultural sector (Sousa et al., 2018). Because of this, South Africa's food security is still in jeopardy. For instance, declining livestock and agricultural yields resulted in lower farm income and less food availability in many provinces (Masipa, 2017; Mugambiwa & Tirivangasi, 2017). The sustainability of South Africa's agriculture sector, which supports the livelihoods of over 70% of the population by providing food, income, and employment, is intricately linked to the food security of rural households (Cammarano et al., 2020). As climate change poses significant threats, ensuring food security for rural households has become a critical challenge. Rural areas, dominated by smallholder farmers who rely heavily on rainfall, are disproportionately vulnerable to the debilitating impacts of climate change, exacerbating the need for urgent action (Shisanya & Mafongoya, 2016). More thorough research is required to determine how AES affect the food security of smallholder farmers' households in South Africa, where smallholder agriculture is one of the primary income sources for most rural households (Oluwatayo, 2019).

2.4. Food security status of the smallholder farmers

One of humanity's basic needs and a requirement for living is food. The globe produces enough food to feed all seven billion people today, yet owing to problems with poor distribution, around a billion people still go hungry (Daszkiewicz, 2022). Most member states of the Southern African Development Community (SADC) rely primarily on agriculture to support economic growth and rural livelihoods. Smallholder farmers make up most farmers in all SADC states except South Africa. Almost 70% of people in most SADC countries get food, money, and jobs from the agricultural sector (SADC, 2020).

Furthermore, the Gross Domestic Product (GDP) of most SADC countries is mainly driven by agriculture. Additionally, about 13% of southern Africa's overall export earnings come

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from the agricultural sector. Southern Africa's agricultural sector's success significantly impacts the region's social and political stability, economic growth, and food security (SADC, 2020).

However, due to low agricultural output and restricted development, achieving food security is challenging for most SADC countries. Numerous factors contribute to poor agricultural performance, such as insufficient market access, little incentives for intensifying agriculture, low soil fertility, and adverse regulations (Nhemachena et al., 2018). This already troubled industry in southern Africa is further strained by climate change. Extreme weather events are a sign of climate change that negatively impacts agriculture in southern Africa. These occurrences include unpredictable weather, heat stress, frequent droughts, floods, temperature increases, and insect invasions (Mafongoya et al, 2019). Food and nutritional insecurity will, therefore, probably continue to rise in southern Africa unless sufficient, long-term remedies are implemented, impacting the lives of millions of marginalized people who depend on agriculture either directly or indirectly.

In southern Africa, cereal crops dominate agricultural trade, serving as the primary food source for the majority of the population. Cereals occupy over 50% of the region's agricultural land, with maize being the most prominent crop, covering more than 40% of the total harvested area (Hachigonta, 2013). It will not be sustainable for the SADC area to maintain levels of food security and economic growth if the yield of the cereal crop, maize, does not rise to keep up with the growing demand. Due to slower rates of both population growth and grain production growth, the per capita production of food in the SA has gradually declined over the last five years by 15.3%, increasing the need for food imports (FAO, 2022).

On average, sub-Saharan African (SSA) farmers often yield only 1 t/ha of cereals annually (FAO, 2022). Cereal yields were predicted to rise by 3.6% in Madagascar between 2020 and 2022 but to fall by 14.1% in Malawi, 4.5% in Mozambique, 8.5% in South Africa, 22.2% in Zambia, and 42.3% in Zimbabwe (FAO, 2022). Therefore, according to United States Agency

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for International Development (USAID) 2017, raising cereal yield is essential to boosting food security, raising incomes, battling poverty, and lowering the cost of food imports into southern Africa. According to FAO (2021), nearly 21 percent of Africans experienced extreme hunger in 2020, double the percentage reported by other global regions. Furthermore, according to Gebre (2021) and the World Health Organization (2019), over 50 percent population faces moderate to severe food insecurity, comprising approximately one-third of the global total 799 million out of 2.37 billion people projected to experience food insecurity worldwide. West and East Africa have far higher rates of food insecurity than other regions; approximately 68 percent and 65 percent, respectively, of people there experience moderate to severe food insecurity (FAO, 2021).

Although there is broad agreement on this food security concept, there is lack of agreement on an accepted measure to determine the common elements driving food insecurity across many nations, demographic groups, and age ranges (Smith et al., 2017). This is due to the fact that the underlying food insecurity causes are complex and challenging to comprehend, particularly in Africa (Kansiime et al., 2021), which increases a need to comprehend the scope and determinants of food insecurity across various age groups and population categories (Wieck et al., 2014). According to Matavel et al (2022), identifying food-insecure people or households and characterizing the extent of their insecurity through measurements is a crucial component of strategies to achieve food security and will serve as a foundation for tracking the effectiveness and progress food security initiatives.

There are four main components of food security: cost, accessibility, availability, and use. Food availability is the state of having enough food to satisfy demand on both an individual and a market level in both formal and informal marketplaces. Increasing food production both locally and through imports is another aspect of this. According to Acheampong et al (2022), food accessibility is defined as having the financial and material means to purchase the amount of food required for abalanced diet. This refers to a person's capacity to consistently and timely meet their eating needs. Smallholder farmers mostly rely on their own output, gifts, exchanges, borrowing, food aid, and purchases to facilitate their access to food.

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Most smallholder farmers depend heavily on their own produce; limiting their access to other food items they do not cultivate (Huang & Tian, 2019; Nchanji & Lutomia, 2021). Food stability encompasses the consistent availability, accessibility, and consumption of food at all times. Food utilization, on the other hand, refers to the effective consumption of available and accessible food items by individuals or households, involving proper processing and preparation techniques (Acheampong et al., 2022). The stability of these three components availability, accessibility, and utilization is crucial for optimal food use, and the physical and financial accessibility of food are all factors that matter (Van Meijl et al., 2020). The growing human population drives global demand for agricultural products (Batista, 2018). The current population of the globe is approximately 7.9 billion, and it is anticipated to grow to nearly 10 billion by 2050 (Kumar et al., 2018; Glick, 2014; Debnath & Conway, 2012). Feeding the current large population, which will undoubtedly grow over time, is a big undertaking because the need for food rises along with the global population (Mahanty et al., 2017).

To mitigate the impacts of population growth on food security, agricultural practices have evolved to incorporate various yield-enhancing and crop-protection strategies. The use of synthetic fertilizers, pesticides, and insecticides have become increasingly prevalent, aiming to maximize crop yields, accelerate growth, and safeguard harvests against pests and diseases (Egamberdieva et al., 2015). The safety, sustainability and security of the food supply have become major public concerns as a result of the usage of the fertilizers and insecticides (Bruinsma, 2009; Liu & Pan, 2015). Improving food security and reducing poverty are challenges that many African nations must overcome (World Bank, 2016). Low agricultural returns, ecological problems like weed and pest management, nutrient cycling, nitrogen fixation, soil regeneration, and food security for the general public but especially for smallholder farmers are among the difficulties these nations face (Msangi, 2014 and Nwajiuba et al., 2015).

According to Nwajiuna et al (2015), ssignificantly fewer fallow periods are reportedly occurring, particularly in several African nations south of the Sahara. Regretfully, inadequate investments in sustainable agricultural intensification and a shift away from diversification toward mono cropping go hand in hand with the reduction (Nwajiuba et al.,

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2015). Due to these circumstances, there is less food available and a fall in agricultural output (Wekesa et al., 2018). In Africa, majority of smallholder farmers in Africa make living exclusively from farming. To improve food security, they require services for agricultural extension (Ochieng et al., 2017).

2.5. Summary of the literature

The literature review highlights the theory that underpins the study which is the theory of consumer behavior which includes the decision making process of smallholder maize farmers, the crucial role of Agricultural Extension Services (AES) in agricultural development, food security, and poverty reduction. AES provides farmers with knowledge, skills, and technologies to improve productivity and income. However, South Africa faces significant food insecurity challenges, with approximately 13.4 million households experiencing inadequate or severely inadequate access to food. Smallholder farmers, who are critical to food security, face challenges such as low agricultural productivity, limited access to markets, and climate change. The importance of AES for smallholder farmers cannot be overstated. AES can help improve productivity, income, and food security among these farmers. However, climate change poses significant threats to food security, particularly for smallholder farmers who rely heavily on rainfall. Other challenges facing smallholder farmers include low agricultural returns, ecological problems, and limited access to markets.

To address these challenges, investing in AES, implementing climate-smart agricultural practices, and improving market access for smallholder farmers are essential. By doing so, smallholder farmers can improve their productivity, income, and food security, ultimately contributing to the country's overall food security and economic growth. Furthermore, understanding the scope and determinants of food insecurity across various age groups and population categories is crucial for developing effective strategies to achieve food security. Overall, the literature review emphasizes the need for a comprehensive approach to address food insecurity in South Africa, with AES playing a critical role in supporting smallholder farmers. By investing in AES and implementing sustainable agricultural practices, South Africa can improve food security, reduce poverty, and promote economic growth. The next chapter present the methodology of the study.

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CHAPTER THREE
RESEARCH METHODOLOGY

3. INTRODUCTION

Chapter three provides the description of study area, research design, population and sampling procedure, data collection, data analysis, ethical consideration, and expected study outcome. According to Dawson and Catherine (2002), research methodology outlines the suggested framework and the planned procedures and techniques in a study, including data collection techniques, data interpretation, and analysis. Information on the research techniques applied in a study is provided by research methodology. It includes the goals, the research questions, and the techniques employed to gather information or provide answers to the research questions (Clark, 2005).

3.1. Description of the study area

The study was carried out in South Africa, Limpopo Province, specifically in Makhado Local Municipality. Africa's southernmost nation is South Africa. South Africa borders Zimbabwe, Botswana, Mozambique, Swaziland, Namibia, and Lesotho. South Africa's northernmost province is called Limpopo (South African Maritime Safety Authority, 2008). The province's western and northern borders are formed by the Limpopo River, thus its name (Young, 2019). According to Statistics South Africa (2015), Makhado Local Municipality is a municipality in the South African province of Limpopo, situated in the Vhembe region. Makhado Local Municipality's coordinates are 23.1138°S, 29.9741°E. According to Makhado Local Municipality (2023), there are 38 wards in the municipality (ward 1 to ward 38). The population is estimated at 502,397 people (LIM344, 2022). However, in Makhado Local Municipality Louis Trichardt, Nzhelele and Tshakhuma was selected due to its prevalence of smallholder maize farmers which aligns with the study focus on the smallholder farmers and allows for the in-depth examination of effectiveness of AES in enhancing food security. Food security is significant in Makhado Local Municipality, and the study area is likely to benefits from the research that aims to improve effectiveness of AES in enhancing food security. The primary activity of residents of the study area is smallholder farming providing livelihood opportunity for the majority. The selection of these three areas was determined by study groups organised by Department

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of Agriculture and Rural Development in Makhado offices as they indicated it is assessable to many farmers in different villages.

Figure 3.1 shows the study area in Limpopo Province, *showing the different district of Limpopo* and figure 3.2 shows *Vhembe District Municipalities, showing the location of the Makhado Local Municipality*



Figure 3.1: Limpopo Province, showing the different district of Limpopo. Source www.municipalities.co.za (accessed on 10 July 2023)



Figure 3.2: Vhembe District Municipalities, showing the location of the Makhado Local Municipality. Source www.municipalities.co.za (accessed 10 July 2023)

The research study occurred in the Makhado Local Municipality, located within the Limpopo province of South Africa. It involved conducting interviews with maize farmers situated in the

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Makhado Local Municipality and engaged in the sale and consumption of maize. The Makhado Local Municipality is located in the Limpopo province of South Africa and is characterized by a diverse range of socioeconomic, topographic, and climatic features. The municipality has a population of approximately 502,397 people (LIM344, 2022). The primary activity of residents is smallholder farming, which provides a livelihood opportunity for the majority. The area is characterized by high levels of poverty and unemployment, which can impact on the food security status of households. Makhado Local Municipality is situated in the Vhembe region of Limpopo province, which is characterized by a diverse range of topographic features, including mountains, valleys, and plains (LIM344, 2022). The area's topography can impact on agricultural activities, with some areas being more suitable for certain types of crops. According to Phethi and Gumbu (2019), the study area has a subtropical climate, with hot summers and mild winters. They noted that area experiences a rainy season during the summer months, which can impact on agricultural activities. Climate variability can also affect crop yields and food security. The municipality has a well-developed physical infrastructure, including roads, bridges, and buildings. However, the condition of some of these infrastructure elements can be a challenge, particularly during the rainy season. The access of infrastructure elements can be a challenge for some smallholder farmers, which can impact on their ability to sell their produce and access financial services. The physical and economic infrastructure in the area can impact on smallholder farmers' ability to access markets, storage facilities, and financial services, which can affect their livelihoods and food security.

3.2. Research design

According to Organisation for Economic Co-operation and development (OECD) (2015), research is the process of solving problems by means of methodical study and original work done to broaden the body of knowledge. Furthermore, the essence of every research project comprises comprehending the study's aim and formulating a well-defined strategy to tackle research concerns and obstacles. Research design is a strategic way of inquiry used to address research challenges, connect methodologies to results, and test study hypotheses (Maree, 2010). A quantitative research design was used in the study; this involved the administration of structured questionnaires. This study design is important because of the nature of the study focusing on describing, summarising,

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analysing and interpreting the results to be obtained when undertaking the study. Face-to-face interviews were used to structure questionnaires for quantitative data.

3.3. Population and sampling method

In a population of 948 smallholder farmers, 250 smallholder maize farmers were interviewed for the study. Multistage sampling was used in the study. Every farmer in the population had equal chance of being chosen, attributable to the advantages of the multistage process (Ross, 2005). Multistage sampling is the process of collecting samples gradually utilizing progressively smaller sampling units at each stage (Joseph et al., 2014). Multistage sampling includes grouping the population (or clusters) for sampling purposes; it can be a sophisticated kind of cluster sampling. Next, a random selection of one or more clusters is made, and a sample of each cluster is taken. Samples are taken from the population by grouping it into several primary stages, which are then subdivided into groups or secondary stages, and so on (Elfil & Negida, 2017).

Multistage sampling was used to select the municipality, which is Makhado Local Municipality, wards, villages, and individual smallholder maize farmers in Limpopo Province, to assess the effectiveness of AES. The population of interest was the smallholder maize farmers in the Vhembe District, Limpopo Province, South Africa. The Vhembe district was divided into different municipalities (Thulamela, Makhado, Musina, Collins Chabane Local Municipality). Makhado Local Municipality was selected as the area of interest. The Department of Agriculture and Rural Development (DARD) Makhado were informed of the research. They organized farmers study groups in different areas in Makhado Local municipality. Those areas include Louis Trichardt, Nzhelele, and Tshakhuma area. The reason for selecting those areas was because it was the centers for all maize farmers in Makhado. The number of smallholder maize farmers was randomly selected to form a representative sample depending on the availability in the study group. A random sample of 250 farmers was selected from villages within Makhado local municipality

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3.4. Data collection method

Primary data were collected from smallholder maize producers; structural questionnaires were designed for collection of both qualitative and quantitative data. Data were collected by administering the questionnaire through one-on-one interviews with the respondents. One-on-one interviews reduced the crucial data lost because of question misunderstandings (Jamshed, 2014). Likert-scale survey instruments were used to collect the data. The questions focused on the effectiveness of the extension services, which emanated from the role of AES. Five-point Likert scale questions was used to ask the questions: 1 = Very ineffective; 2 = Ineffective; 3 = Average; 4 = Effective; and 5 = Very effective. The reason for choosing the Likert scale was because the researcher wanted to measure the attitudes and opinions of smallholder maize farmers on different statements, asking the rate of effectiveness or ineffectiveness. The questionnaire was administered to farmers in the study area to find out the effectiveness of AES. When there is something the responders did not understand, they asked the interviewer to clarify. According to Dirwai and Gwimbi (2003), a questionnaire should be designed to address the research goals. This implies that the researchers should limit their investigation to relevant components only. The identical questions were asked to various respondents in a questionnaire. Field assistants were able to use the questions during interviews because they were straightforward and written in plain English. Since Tshivenda is the primary language spoken in the study area, the questionnaires were, when needed, translated into the languages of choice. The researcher supplied the questionnaires. The data collection process took place from 20 September to 14 October 2024. The food security data was collected from smallholder maize farmers using questionnaires guided by the objective 3 (to determine food security status of smallholder maize farmers). Section C on appendix A

3.5. Methods of data analysis

The data obtained from the study was recorded using Microsoft Excel 2016 (version 16) and subsequently analysed using the Statistical Package for Social Sciences (IBM SPSS Statistics 29) and STATA (version 16.0)

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3.5.1. Objective one: To identify and describe the socioeconomic characteristics of smallholder maize farmers

Descriptive statistics were used to analyze the socioeconomic characteristics of smallholder maize farmers. This involved using tables, frequencies, percentages, sums, graphs, charts, and averages.

3.5.2. Objective two: To identify different services rendered by extension officers and their effectiveness.

Descriptive statistics were also employed to analyse and summarise the different services rendered by extension officers. Likert scale measure was used to collect the interval data. This involved using tables, frequencies, percentages, sums, graphs, charts, and averages. Services that extension officers provide include training, maize management, climate change, cultivation practices, fertilization, plant protection (pests, weeds, and disease control), marketing, field demonstrations, workshops, price, cultivation practices, and farming techniques. The effectiveness of AES can be measured using delivery, such as farmer training, farm/home visits, office calls, field demonstrations, field/farmers days, and workshops/open discussions (Somanje et al., 2021). The effectiveness of AES was determined by adding all the services provided by extension agents and calculating the average. Then the total services received by each farmer were calculated and the average per farmer was determined. If the average per farmer fell below the average, AES was considered ineffective for that farmer. Conversely, If the average per farmer exceeded the average, AES was deemed effective.

3.5.3. Objective three: To determine the food security status of smallholder maize farmers

Foster Greer Thorbecke (FGT) index was used to determine the food security status of the farmers. According to Thorbecke et al. (2010), the Foster–Greer–Thorbecke indices are a family of poverty indicators. A popular option in development economics, the most widely used indicator from the family, FGT, combines income inequality and poverty by giving greater weight to the poverty of the poorest individuals. The FGT was used to generate the food poverty line. The food poverty line was used to group and categories the response into food secure and food insecure group, the food secure group was one

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and food insecure group was zero which was used as the dependent variable for Probit model.

The FGT model can be expressed as follows

$$FGT_{\alpha} = \frac{1}{N}\sum_{n=1}^{H}\left(\frac{z - y_i}{z}\right) \quad \ldots\ldots\ldots\

Table 3.1 shows the description of the variables used in the study where we have Dependent variable, food security status (generated from the food poverty line obtained using the FGT index) and independent variables which include explanatory variables.

Table 3.1: Description of variables

Dependent variable: Food security status (generated from the food poverty line obtained using the FGT index)			
Independent variables	**Measurement of variables**	**Units of measurement**	Expected outcome + / -
1. Educational status (X_1)	Have formal education 1 and 0 otherwise	Dummy	+
2. Age (X_2)	Age of the farmer	Years	+
3. Gender (X_3)	1 if male and 0 if female	Dummy	+
4. Income (X_4)	Household income per month	Rand	+
5. Household size (X_5)	Number of people in the household	Continuous	-
6. Location (X_6)	If located in rural area 1; if not 0	Dummy	-
7. Type of participation (X_7)	Level of participation AES (1 full-time; 0 part time)	Dummy	+
8. Land ownership (X_8)	If the farmland is own property 1; if not 0	Dummy	+
9. Effectiveness status (X_9)	1 effective: if not 0 (generated from Likert scale)	Dummy	+
10. Experience (X_{10})	Farming experience in maize	Continuous	+
11. Land (X_{11})	land size in hectares	Continuous	+
12. Marital Status (X_{12})	If married 1; if not 0	Dummy	-
13. Member of association (X_{13})	If the farmer belongs to associations 1 and 0, otherwise	Dummy	+
14. Access to market (X_{14})	Access to market 1; 0 if not	Dummy	+

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15. Access to credit (X_{15})	1 if have access; 0 if not	Dummy	+

Source: Author compilation (2025).

3.6. Expected outcome

The study aimed to provide understanding of the socioeconomic characteristics of smallholder maize farmers, shedding light on their income, education, land ownership, and other factors influencing their livelihoods. Secondly, the study identified and described the various services provided by extension officers, such as training, advisory support, or resource access, which are crucial in improving agricultural practices. The research revealed whether these services significantly contribute to improving the food security of smallholder maize farmers. Furthermore, it determined the food security status of these farmers, gauging their access to sufficient, safe, and nutritious food.

Finally, by examining the relationship between the effectiveness of AES and food security, the research revealed whether these services significantly contribute to improving the food security of smallholder maize farmers. These outcomes provide valuable insights for policymakers, extension services, and the agricultural community to enhance the livelihoods of smallholder maize farmers and ensure food security in their regions. Hence, those outcomes provide information about the farmers and help policymakers understand how effectively AES are rendered.

3.7. Ethical considerations

An ethical clearance certificate was obtained from the University of Venda ethics committee before data collection. Interviews with smallholder farmers were done as part of the regular routine that precedes the start of the study of the various meeting authorities, including the village council, which is responsible for farming. When gathering data, participant rights and ethical considerations were considered. This is consistent with Bless and Higson-Smith's (2000) claim that participant rights must be considered during the data collection process. Farmers were advised of their rights to participate or not participate and to stop participating if they feel unable to continue. Every volunteer selected for this study received a thorough explanation of the purpose and goals of the investigation. Respondents were asked for permission to be interviewed during the data

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gathering process. Farmers were given assurances regarding the privacy and confidentiality of the information gathered during the survey. No farmers were coerced, threatened, compensated, or bought off. Participants provided direct informed consent for this study by signing consent forms, attesting to their free will to participate. The researcher for this study guaranteed confidentiality and anonymity, and the data was only utilized for the intended aim of the study (Kumar & Hansra, 2000).

3.8. Limitations of the study

- The study area comprises a scattered farmer population, which causes challenges in reaching those in areas with inadequate road infrastructure.
- Additionally, sampling was extremely challenging as some farmers were not officially registered with the Department of Agriculture, and extension officers were unaware of their existence.

3.9. Summary of the chapter

This chapter outlines the research methodology used in the study, covering the study area, research design, population and sampling procedure, data collection, data analysis, and ethical considerations. The study was conducted in Makhado Local Municipality, Limpopo Province, South Africa, with a population of approximately 502,397 people. A quantitative research design was employed, involving structured questionnaires administered through face-to-face interviews with 250 smallholder maize farmers selected using multistage sampling. The study used various statistical tools, including the Foster Greer Thorbecke (FGT) index to determine food security status and the Probit model to examine the relationship between food security and the effectiveness of Agricultural Extension Services (AES). The objectives of the study were to identify and describe the socioeconomic characteristics of smallholder maize farmers, identify different services rendered by extension officers and their effectiveness, determine the food security status of smallholder maize farmers, and examine the relationship between food security and effectiveness of AES.

The study aims to provide insights into the socioeconomic characteristics of smallholder maize farmers, the effectiveness of AES, and the relationship between AES and food security. The findings will inform policymakers and extension services to enhance the livelihoods of smallholder maize farmers and ensure food security. The study obtained ethical clearance from

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the University of Venda ethics committee and ensured that participants' rights were respected during data collection. However, the study faced challenges in reaching farmers in areas with inadequate road infrastructure, and some farmers were not officially registered with the Department of Agriculture. The next chapter present the results and discussion.

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CHAPTER FOUR

RESULTS AND DISCUSSION

4. INTRODUCTION

This chapter presents the study findings and interprets the results in relation to the research objectives.

4.1. Socioeconomic characteristics of maize farmers

4.1.1. Summary statistics of continuous socioeconomic variables

The descriptive statistics of the respondents reveal several key characteristics. In table 4.1, the age range of respondents was quite broad, spanning 73 years, with a minimum age of 21 years and a maximum age of 94 years. The mean age was 60.92 years, with a standard deviation of 14.73 years, indicating a relatively high level of variability in the age of the respondents. Regarding years of formal education, the respondents reported a range of 0-22 years, with a minimum of 0 years and a maximum of 22 years. The mean number of years of formal education was 10.80 years, with a standard deviation of 5.10 years.

The results show that farmers' experience level range from 1 to 60 years with a mean of 22.37 years and a standard deviation of 15.97 years. This shows that the respondents had a wide range of experiences, with some having just started farming and others having several decades of experience. The total income of the respondents ranged from R500 to R30000, with a mean of 4100.84 and a standard deviation of 3944.15. This indicates a high level of variability in the income of the respondents, with some earning relatively low incomes and others earning much higher incomes. The amount spent on food (food expenditure) by the respondents ranged from 100 to 5600, with a mean of 1858 and a standard deviation of 856.89. This shows that the respondents had varying levels of expenditure, with some spending relatively small amounts and others spending much more significant amounts. Finally, the land size of the respondents ranged from 0.4 to 35 hectares, with a mean of 1.85 and a standard deviation of 2.79. This indicates a moderate

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level of variability in the land size of the respondents, with some having relatively small plots of land and others having larger plot.

Table 4.1: Summary statistics of continuous socioeconomic variables

Summary statistics						
	n	Range	Minimum	Maximum	Mean	Standard deviation
AGE	250	73	21	94	60.9160	14.72577
YEARS FE	250	22.00	.00	22.00	10.7960	5.10240
YEARS EX	250	59.00	1.00	60.00	22.3680	15.97088
TOT INC	250	29500.00	500.00	30000.00	4100.8400	3944.15399
SPEND	250	5500.00	100.00	5600.00	1858.0000	856.88565
L SIZE	250	35.00	.40	35.00	1.8506	2.79483
Valid n (listwise)	250					

Source: Survey data (2025)

Table 4.2 shows a comprehensive overview of the characteristics of smallholder maize farmers in the study area. The average land size cultivated by respondents is approximately 1.85 hectares, with a median of 1.29 hectares. This suggests that most of the respondents are smallholder farmers, with limited landholdings. The average annual maize yield is approximately 13 676 kilograms, with a median of 10000 kilograms. This indicates that while some farmers can produce significant quantities of maize, others struggle to achieve optimal yields.

The average monthly income from maize farming is approximately R6153.60, with a median of R4000. This suggests that while some farmers generate a significant income from maize farming, others struggle to make ends meet. The average amount spent on food per month is approximately R1616.80, with a median of R1650. This indicates that a significant portion of farmers' income is spent on food, highlighting the significance of food security for these households. The standard deviation and variance of the variables suggest significant variability in the data, indicating that not all farmers are experiencing

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the same levels of success. The range of values for each variable is also extensive, further highlighting the diversity of experiences among smallholder maize farmers in the study area. Farmers with more extensive landholdings may be able to produce more maize, generating higher incomes. However, this relationship is not necessarily straightforward, and other factors such as soil quality, climate, and access to inputs may also play a role. Overall, the summary statistics provide a valuable snapshot of the characteristics of smallholder maize farmers. They highlight the challenges faced by these farmers, including limited landholdings, variable maize yields, and limited incomes from maize farming.

Table 4.2: Summary statistics of land size, annual maize yield, total income, and total amount spent on food

	L SIZE	AMY (KG)	INC M	SPEND
N	250	250	250	250
Mean	1.8506	13.6760	6153.6000	1616.8000
Std. Error of Mean	.17676	.77579	535.11672	91.14087
Median	1.2860	10.0000	4000.0000	1650.0000
Mode	1.00	10.00	.00	.00
Std. Deviation	2.79483	12.26625	8460.93830	1441.06364
Variance	7.811	150.461	71587476.948	207664.418
Range	35.00	77.00	50000.00	11500.00
Minimum	.40	5.00	.00	.00
Maximum	35.00	80.00	50000.00	11500.00
Sum	462.64	3419.00	1538400.00	404200.00

Source: Survey data (2025)

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Table 4.3 presents the gender, race, marital status, age distribution, education level, and years of experience, occupation status, and sources of household income. These demographic characteristics provide valuable insights into the composition of the sample population and have important implications for understanding the experiences and perspectives of smallholder farmers.

Table 4.3: Demographic characteristics of respondents

		Frequency	Percentage
Gender	Female	116	46.4
	Male	134	53.6
Race	Black African	250	100
Marital status	Single	53	21.2
	Married	141	56.4
	Divorced	11	4.4
	Widowed	45	18.0
Age	21-30	8	3.2
	31-40	20	8.0
	41-50	33	13.2
	51-60	39	15.6
	More than 60	150	60.0
Education level	No formal education	13	5.2
	Primary	74	29.6

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	Secondary	127	50.8
	Tertiary	36	14.4
Years of experience	0-10	73	29.2
	11-20	77	30.8
	21-30	29	11.6
	31-40	26	10.4
	More than 40	45	18
Occupation status	Employed	19	7.6
	Unemployed	126	50.4
	Self employed	105	42.0
Fulltime farmer	No	60	24.0
	Yes	190	76.0
Source of household income			
Agricultural activities	Yes	167	66.8
Salaried employment	Yes	9	3.6
Business	Yes	13	5.2
Social grant	Yes	172	68.8
Pension	Yes	9	3.6
Land ownership	No	79	31.6

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	Yes	171	68.4

Lease	No	239	95.6
	Yes	11	4.4
Communal	No	180	72.0
	Yes	70	28.0
Selling method	Not selling	74	29.6
	Processing company	67	26.8
	Roadside stand	91	36.4
	Farmers market	17	6.8
Process maize	No	101	40.4
	Yes	149	59.6
Processing machine	No	247	98.8
	Yes	3	1.2
Pay for processing	No	24	9.6
	Yes	226	90.4
Maize produced	Consumption	82	32.8
	Selling	8	3.2
	Both	160	64.0
Access to market	No	166	66.4

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	Yes	84	33.6
Access to credit	No	224	89.6
	Yes	26	10.4
Agricultural Extension is Effective	Yes	72	20.8
	No	178	71.2

Source: Survey data (2025)

In terms of gender distribution, the results indicate that males slightly outnumber females, with 53.6% of the respondents were male and 46.4% were female. This uniform distribution allows for a balanced representation of both genders. This results correlate with Belemu and Oluwatayo (2025) who found that Vhembe District is dominate by male farmers. There was gender imbalance, with 63 8% males and 36.2% females, consistent with Gosa et al. (2022). The racial composition of the sample population is noteworthy, with 100% of the respondents identifying as Black African. This racial homogeneity provides a unique opportunity to explore the experiences and perspectives of Black African individuals within this specific context. The majority (56.4%) are married, followed by single (21.2%), widowed (18.0%), and divorced (4.4%) individuals. This distribution shows that the sample includes a wide range of marital statuses, which may influence the respondents' perceptions, attitudes, and experiences. However, majority of the respondents (60.0%) were above 60 years old, followed by those in the 51 - 60 age (15.6%). The remaining age groups were relatively smaller, with 13.2% of respondents falling within the 41-50 age range, 8.0% in 31 - 40 age range, and 3.2% in the 21 - 30 age range. This age distribution suggests that the sample population is skewed toward older individuals.

The education level of the respondents reveals a diverse range of educational backgrounds. Most of the respondents (50.8%) had a secondary level of education, followed by those with a primary education (29.6%). Only 14.4% had tertiary education, while 5.2% reported having no formal education. This distribution highlights the importance of considering educational background in the study. However, the years of

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experience of the respondents show a varied range of work experience with most of the respondents (29.2%) had 0-10 years, followed by those with 11-20 years (30.8%). The remaining respondents had more extensive work experience, with 11.6% having 21-30 years of experience, 10.4% having 31-40 years, and 18.0% having more than 40 years. This distribution suggests that the sample population has a wealth of experience in Agriculture. Furthermore, the occupation status of the respondents reveals a mix of employment statuses. Most of the respondents (50.4%) were unemployed, followed by those who were self-employed in non-agricultural trade (42.0%). A smaller proportion of respondents (7.6%) were employed. Additionally, 76.0% of the respondents identified as full-time farmers, indicating a strong presence of agricultural professionals in the sample population.

The source of household income reveals that 66.8% of households depend on agricultural activities. However, 68.8 percent of households reported receiving social grants highlighting the importance of social welfare programs in supporting rural livelihoods. The vast majority (96.4%) of respondents reported not being in salaried employment, while only 3.6% reported being employed. This shows that the respondents are largely self-employed or reliant on non-wage sources of income. Furthermore, 94.8% of respondents reported not being involved in business activities, while 5.2% reported being involved in business.

Land ownership is a critical aspect of farming, and the results show that 68.4% of farmers owning the land they farm on, while 31.6% did not own the land they farm on, they use communal land. This shows that a significant proportion of farmers have control over their land, which can impact their productivity and decision-making. Regarding lease arrangements, most respondents (95.6%) did not lease their land to others. This indicates that most farmers prefer to manage their own land, which can be beneficial for their agricultural productivity. Communal farming is also practiced by 28% of the respondents, implying that many farmers benefit from shared resources and collaborative farming practices.

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The results show that 73.2% of the respondents were not part of any farming organization, which may indicate a lack of resource access, training, and support. Primary methods of selling produce were through roadside stands (36.4%) and processing companies (26.8%). A substantial proportion (29.6%) of respondents did not sell their produce, an indication that they are subsistence farmers or face challenges in accessing markets. The study also shows that 59.6% of the respondents processed their maize, while 40.4% did not. However, only 1.2% of respondents owned a processing machine, indicating a reliance on external services. The results highlight significant challenges farmers face in accessing markets and credit. The results show that 66.4% of the respondents did not have access to markets, while 89.6% did not have access to credit. These constraints can limit the growth and development of farming enterprises, making it difficult for farmers to improve their productivity and livelihoods.

4.2. Services rendered by extension officers and their effectiveness

Extension officers' role in supporting smallholder farmers is important in improving agricultural productivity and food security. Extension officers provide various services, including advisory services, training, and support accessing inputs and markets. This study investigated the services rendered by extension officers and their effectiveness, as perceived by smallholder farmers. Respondents were asked to indicate their level of effectiveness on the several statements on service rendered by extension services; they were asked to indicate their level of effectiveness for each challenge ranging from very ineffective (1), ineffective (2), average (3), effective (4) and very effective (5), the results were ranked and presented in Table 4.4.

The findings indicate that extension officers are most effective in organizing group meetings for farmers, with a mean of 3.78. This shows that group meetings were a highly effective way for extension officers to disseminate information and provide training. Antwi and Stringer (2021) showed that agricultural extension plays a vital role in disseminating information and promoting new technologies. By organizing group meetings, extension officers can reach a significant number of farmers, promote peer-to-peer learning, and build stronger relationships with the farming community. Other services that were ranked highly in terms of effectiveness include providing production inputs, formal training, and

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advice to farmers. These services are critical in supporting farmers' productivity and livelihoods, and the high mean scores indicate that extension officers are making a positive impact in these areas. The provision of production input including seeds and fertilizers is essential for farmers to improve their crop yields and incomes. Formal training and advice provided by extension officers can also help farmers acquire new skills, adopt best practices, and make informed decisions about their farming operations. This is consistent with Ryan (2023) who stated that extension help farmers adopt Morden and improved methods that increase productivity and efficiency, and disseminate valuable information related to crop.

Table 4.4: Services rendered by extension officers and their effectiveness

Services rendered	Sum	Mean	Rank
1. Assist in identifying the problem	759	3.03	7
2. Assist in overcoming the problem	654	2.62	17
3. Introduce new technologies	598	2.39	20
4. Create opportunities for farmers? (such as marketing and processing)	658	2.63	16
5. Help farmers to put new information into use	744	2.98	10
6. Provide advice to the farmers	814	3.26	**4**
7. Provide maize management	756	3.02	8
8. Provide workshops for farmers	786	3.14	**5**
9. Provide formal training to farmers	847	3.39	**3**
10. Provide production inputs	855	3.42	**2**
11. Visit the farm for identification of the Problem	733	2.93	11

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12. Provide technical services such as seeds and soil testing services	717	2.87	12
13. Provide farming knowledge and Education	747	2.99	9
14. Assist in setting up the price of the product	687	2.75	16
15. Help on how to deal with weed Management	615	2.46	19
16. Assist with cultivation practices	619	2.48	18
17. Advice about plant protection against climate change	695	2.78	15
18. Bring a solution toward climate change	691	2.76	14
19. Advice on plant protection	715	2.86	13
20. Assist farmers with water management	757	3.03	6
21. Organize group meetings for farmers	945	3.78	**1**
22. Visit the farm	577	2.31	21

Source: Survey data (2025)

On the other hand, the results also highlight areas where extension officers need to improve their services. For example, visiting farms and providing technical services such as seeds and soil testing were ranked lower in effectiveness. Similarly, services such as assisting with cultivation practices, helping with weed management, and introducing new technologies were also ranked lower. These findings suggest that extension officers may need additional training or resources to improve their effectiveness in these areas.

Table 4.4 also suggests that extension officers may need to improve their services related to climate change. Services such as providing advice on plant protection against climate change, bringing solutions towards climate change, and assisting farmers with water

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management were ranked lower in effectiveness. Given the increasing importance of climate change adaptation in agriculture, extension officers may need training on providing farmers with climate-smart agriculture advice and support.

4.3. Food security and poverty status of smallholder maize farmers

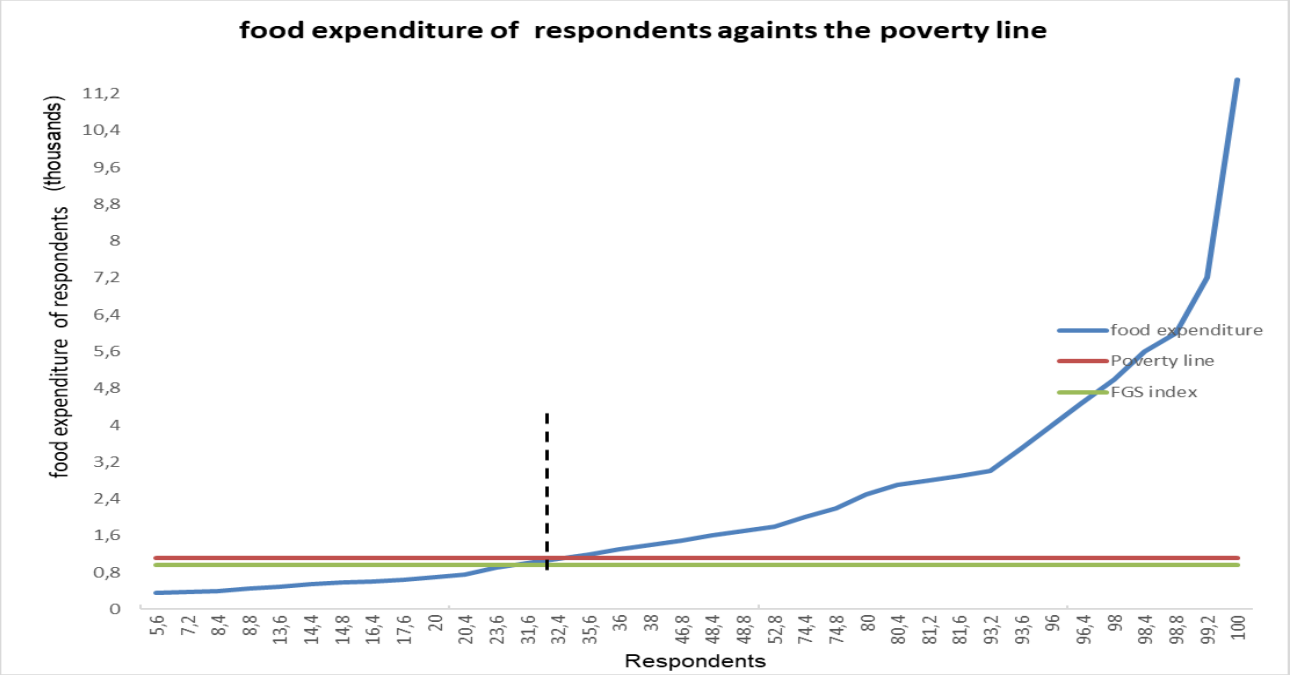


Figure 4.1 shows the line graph showing the food expenditure of respondents against the poverty line. Source: Survey data (2025)

According to Statistics South Africa (2024) report, South Africa's national poverty levels for 2024 are as follows**:** The monthly Food Poverty Line (FPL) is R760 per person. This is the bare minimum needed for a person to satisfy their basic calorie requirements. The Lower-Bound Poverty Line (LBPL) is R1 114 per person per month, which includes the money needed to purchase food and other necessities, even if it means sacrificing some food. It was revealed that R1 751 per person per month is the Upper-Bound Poverty Line (UBPL), which covers sufficient food and non-food necessities.

A popular method for calculating poverty is the FGT poverty index, which considers three factors: The percentage of the population poverty threshold is known as the Headcount Index (P_0). The average difference between the expenditure and the poverty line, which

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indicates the depth of poverty, is known as the Poverty Gap Index (P_1). The Squared Poverty Gap Index (P_2) gauges the disparity among the impoverished. In Figure 4.2, 32.4% of the population lives below the poverty line, which is the headcount ratio. Additionally, the study discovered a 0.1328 (or 13.28%) variance in poverty levels or income inequality among the poor. This indicates a moderate level of disparity in the distribution of resources below the poverty line, with the average income of each poor person being 13.28% below the poverty line.

The ability to support oneself or exercise autonomy, such as the ability to get resources, jobs, or productive assets, may be referred to as sovereignty in this context. According to the research, P2 was 0.0712. This indicates that restricted sovereignty leads to poverty but is less substantial than inequality (spread) since it accounts for 7.12% of the overall poverty gap or severity.

4.4. Food security status of smallholder farmers

Table 4.5 presents the findings on the food security status and the results revealed that 34.4% of smallholder maize farmers in Makhado Local Municipality experienced difficulties in accessing food in the past month/years, primarily due to changes in climatic conditions (6.8%), financial problems (9.2%) and lack of irrigation systems (10.0%). This shows that AES should prioritize addressing these challenges to enhance food security. Furthermore, the findings indicate that 18.4% of respondents face difficulties in accessing essential food items, and 80.8% experience food shortages. The nutritional diversity of the family diet is also a concern, with only 10.4% rating it as excellent. This highlights the need for interventions that promote dietary diversity and improve nutritious food access.

In addition, the study reveals that food shortages are a widespread problem, with 80.8% of respondents experiencing shortages. Approximately 40% of respondents relying on changing eating patterns, 25.2% on reducing portion sizes, and 15.2% on borrowing food, this highlights the need for more effective strategies to address shortage of food and improve food security. The study also highlights the importance of effective AES in enhancing food security. However, the findings show that these services are not reaching all farmers, with 82.8% of respondents receiving no support. Moreover, the type of support

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received by farmers is limited, with 2.4% receiving farmer support grants, 0.4% receiving Pesi, and 18% receiving farming inputs, including pesticides, seeds, fertilizers, and fungicides, emphasizing the importance of access to essential inputs.

Table 4.5: Food security status of smallholder farmers

		Frequency	Percentage
Experienced difficulties	No	164	65.6
	Yes	86	34.4
Specify difficulties	None	164	65.6
	Change in climatic conditions	17	6.8
	Financial problems	23	9.2
	Pests and diseases	2	.8
	Lack of irrigation system	25	10.0
	High food prices	15	6.0
	Limited access to farm inputs	4	1.6
Faced difficulties in assessing essential food items	No	204	81.6
	Yes	46	18.4
Nutritional diversity of family diet	Excellent	26	10.4
	Good	132	52.8
	Fair	81	32.4
	Poor	11	4.4
Food shortages	No	48	19.2
	Yes	202	80.8
Strategy to deal with food shortage	None	48	19.2
	Borrowing food	38	15.2
	Reducing portion size	63	25.2
	Changing eating patterns	101	40.4
	No	207	82.8

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Received support to improve food security	Yes	43	17.2
Type of support	Farmer support grant	6	2.4
	Pesi	1	.4
	Farming inputs	45	18.0

Source: Survey data (2025)

4.5. The relationship between food security and effectiveness of AES

Food insecurity remains a main concern in South Africa, with far-reaching implications for the well-being and livelihoods of smallholder farmers. This study contributes to the ongoing discussion on food security by investigating the factors influencing food security among smallholder maize farmers in South Africa. This section presents the results of the study, which provide valuable insights into the complex relationships between poverty, food security, and smallholder farming in South Africa. Table 4.6 presents the probit regression analysis and further discusses variables that significantly influence the food security status.

The results reveal that age was statistically significant at 5% significant level with a p-value of 0.465 and coefficient of -0.21. The findings suggest that age and food security level are negatively correlated. Assuming all other parameters stay the same, the coefficient of 0.21 indicates that food security status falls by 0.21 for every unit rise in age. The study findings suggest that young farmers are more food secure than older farmers. Even though older farmers have received more extension services than young farmers, older farmers still face structural challenges, such as physical labour limitations, lack of innovation adoption, or reduced farm productivity. This is in agreement with a study by Zmija et al (2020), which show that younger farmers might sometimes be more food secure because of their capacity to embrace innovative farming techniques and better use contemporary agricultural technologies. Additionally, Mumo (2021) stated that younger farmers are more likely to diversify their crops or adopt climate-smart agriculture, which increases their resilience to shocks from the outside world.

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Table 4.6: Probit model results for the relationship between food security and effectiveness of AES

Parameter	B	Std. Error	Wald Chi-Square	Sig
(Intercept)	3.606	1.2271	8.635	0,003
Educational status (X_1)	.163	.2226	.534	0,465
Age (X_2)	-.021**	.0090	5.423	**0,020**
Gender (X_3)	-.031	.3715	.007	0,933
Income (X_4)	1.458***	.7580	3.702	**0,054**
Household (X_5)	-.041	.0328	1.533	0,216
Location (X_6)	4.670E-5	4.9738E-5	.882	0,348
Type of participation (X_7)	-.031	.3715	.007	0,933
Land ownership (X_8)	.009	.0553	.026	0,872
Effectiveness status (X_9)	-.567***	.2093	7.339	**0,007**
Experience (X_{10})	-.233	.4128	.319	0,572
Land (X_{11})	.400	.1804	.047	**.027**
Married (X_{12})	.389	.6203	.393	0,531
Member of association (X_{13})	-.347	.3271	1.129	0,288
Access to market (X_{14})	-.294***	.0976	9.059	**0,003**
Access to credit (X_{15})	-1.446*	.7894	3.358	**0,067**

Source: Survey data (2025). (***, ** & * indicate t-values significant at 1%, 5% and 10% levels respectively.

The study findings highlighted a direct correlation between income level and food security status, as indicated by coefficient of 1.458, which was statistically significant at the 5 percent significant level. This shows that assuming all other variables stay the same, the food security status increases by 1.458 units for every unit rise in income. These results imply that households with higher income levels can purchase more varied, higher-quality food in greater amounts. Additionally, when income levels rise, investing in agricultural inputs, including machinery, seeds, fertilizer, and storage facilities, is possible, this enhances food availability and production. A study by Demont (2022), indicated that

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households with higher incomes are less vulnerable to food insecurity because they can better withstand economic shocks, price volatility, and seasonal shortage

Additionally, with a coefficient of -0.567 and p_value of 0.007, the efficacy of extension services was statistically significant at the 1% significant level. This finding implies that assuming all other variables stay the same, food security status deteriorates by 0.567 units as the perceived efficacy of extension services declines. According to the negative coefficient, food security is negatively impacted by inefficient extension services. The inefficiency in extension service delivery is a significant barrier to agricultural productivity (Okorie et al., 2022). This implies that farmers who do not receive timely, relevant, or practical advice from extension officers are more likely to struggle with food security due to suboptimal farming practices or inability to adapt to new challenges. The implementation of best practices in farming is also severely hampered by inadequate management and limited access to extension services. Moreover, these restrictions frequently lead to less-than-ideal land usage and decreased agricultural output, which impacts family food security (Antwi-Agyei & Stringer, 2021).

The study findings also revealed that land size is statistically significant at the 5% level, with a coefficient of 0.400. Assuming all other parameters stay the same, food security increases by 0.400 units for every unit increase in land size. Farmers may cultivate more crops, diversify their output, and even realise economies of scale on larger plots of land. At the home level, this immediately raises agricultural productivity, income, and food availability. According to research by Adesiyan et al. (2024), farmers may increase food security by allocating more area for cash and subsistence crops on greater land holdings. On the other hand, smallholder farmers' ability to achieve food security has been found to be hampered by limited land access, especially in regions with dense populations or unequal land distribution (Giller et al., 2021).

Additionally, the study discovered that, with a value of -0.294 and p-value of 0.003, market accessibility was statistically significant at the 1% level. Market access and food security status have a regressive relationship. These findings imply that limited market access has negatively impacted food security. Assuming all other parameters stay the same, food

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security status deteriorates by 0.294 units for every unit drop in market accessibility. In this case, a negative relationship was found because majority of respondent indicated that they do not have access to market. Smallholder farmers' difficulties reaching markets, such as distance, transportation expenses, or inadequate infrastructure, may significantly impact these findings and restrict their capacity to sell their goods efficiently. As a result, farmers may see a decline in revenue, which would then impact their capacity to buy enough food that is nourishing. Poor rural road infrastructure is cited as a significant barrier to market participation among smallholder farmers, directly affecting their income and food security (Wondimu, 2023). Lastly, the results showed that credit access is statistically significant at the 5% level, with a coefficient of -1.446 and p-value of 0.067, suggesting that limited access to credit is strongly associated with low food security status. Thus, assuming all other variables stay the same, food security deteriorates by 1.446 units for every unit reduction in credit availability. Reduced agricultural output may result from farmers being unable to invest in essential inputs like seeds, fertiliser, or irrigation systems due to limited access to financial resources. Additionally, it implies that farmers are less likely to grow their businesses or use new technology, which would further hinder their productivity level, ultimately reducing their level of food security. The current study's finding was supported by Fronda (2024), who stated that farmers without access to credit often struggle to overcome financial barriers that limit their ability to scale up production or diversify income sources. This can make them more likely to experience food instability, especially in face of economic shocks, crop failures, or market price fluctuations. Furthermore, smallholders' farmers who have secured financing or have better credit access are better able to allocate funds to inputs that increase efficiency/productivity and stabilise income, thereby reducing food insecurity (Jayne et al., 2021).

4.6. Respondents' suggested measures to improve the food security situation of smallholder farmers

Respondents were asked what measures could improve the food security situation for smallholder farmers. Table 4.7 presents the findings on the strategies that can be

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employed. It was developed from the responses of the farmers, who identified various measures that can be taken to address the food security challenges they face.

Table 4.7: Suggested measures to improve the food security situation for smallholder farmers

Measures	Response	Frequency	Percentage
Education and training	No	226	90.4
	Yes	24	9.6
Improve farm visit	No	237	94.8
	Yes	13	5.2
Equipment	No	214	85.6
	Yes	36	14.4
Extension support	No	63	25.2
	Yes	187	74.8
Land	No	243	97.2
	Yes	7	2.8
Access to water	No	136	54.4
	Yes	114	45.6

Source: Survey data (2025)

The results in Table 4.7 provide valuable insights into the measures that can be taken to enhance food security situation for smallholder farmers. According to respondents, education and training are crucial in improving the food security situation for smallholder farmers. Only 9.6% of the respondents suggested that education and training can improve food security, indicating a lack of awareness about the importance of education and training in agricultural development. They emphasized that they should get education on how to improve farm practices, how to minimise climate change effects, how to get water licenses and water management, and training on training on the introduction of new methods of planting maize and the best way of dealing with weeds.

Respondents (5.2%) emphasized that extension agents should improve farm visits to help identify problems that they face and provide better solutions. Farmers (14.4%) mentioned

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that they should be supplied with farming equipment, including Bushell for irrigation, so they can stop depending on rain and supply the tractors to plow for them.

Respondents (74.8%) emphasized that extension service support, including providing farm inputs, monitoring farms effectively, providing marketing strategies, providing farmers support funds and technical support, providing effective extension services to help maximisation the product, creating an agency under agriculture department focusing specifically on the needs of smallholder farmers and improve their business management strategies to be able to commercialize their operation effectively.

Access to many hectares of land (2.8%) and access to water (provision of boreholes or water systems such as water pumps to keep the farming process going at any season rather than depending on rain) are all important measures that can be taken to improve the food security situation for smallholder farmers. However, the frequency of farm visits, equipment availability, and extension support provision are all areas that require improvement, as indicated by the respondents.

4.7. Summary of the chapter

Chapter 4 presents the study's findings on the socioeconomic characteristics of maize farmers, the effectiveness of extension services, food security and poverty status, and the relationship between food security and Agricultural Extension Services (AES). Key findings include the average age of respondents being 60.92 years, with limited formal education and significant farming experience. Extension officers were found to be most effective in organizing group meetings and providing production inputs, but areas like farm visits and climate change adaptation need improvement. The study also reveals that 32.4% of the population lives below the poverty line, and 34.4% of farmers face difficulties accessing food due to climatic changes, financial issues, and lack of irrigation. The study concludes that effective AES is crucial for enhancing food security and suggests that policymakers prioritize improving extension services, market access, credit access, and land ownership. Respondents also suggested measures like education, improved farm visits, and provision of farming equipment to address food security challenge.

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CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5. Introduction

This chapter provides the summary, conclusion, and recommendation. It provides a summary and briefly discusses the results with respect to the research objectives and research questions of the study. It also provides recommendations for further research opportunities.

5.1. Summary of findings

One of the main pillars of the South African economy is agriculture, to which maize, one of their core crops, contributes. In South Africa, food security can be assessed at both the household and national levels. Food security is improved, and smallholder maize growers are supported in large part by agricultural extension programs. Additionally, the Vhembe District Municipality's smallholder farmers are essential to food production, and the region's entire food supply is directly impacted by their food security. However, issues including low agricultural production, restricted access to resources, and climate change remain a pressing concern to food security.

The primary goal of this study is to assess the effectiveness of AES in enhancing food security among smallholder maize farmers.

Examined were the respondents' socioeconomic attributes, such as gender, race, marital status, age distribution, education level, and years of experience, occupation, and sources of household income. The findings show that, at 53.6%, males slightly outweigh female. The sample population's racial makeup is notable, with all respondents identifying as Black African. Most respondents (56.4%) were married, according to their marital status. According to the age distribution, the bulk of responders (60.0%) were above 60 years. The majority of those surveyed (50.8%) had completed secondary school. The respondents' years of experience, however, reveal a wide range of work experience, with the majority (30.8%) having 11–20 years. Most of those surveyed (50.4%) did not have a

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job. Furthermore, 76.0% of those surveyed said they were fulltime farmers, suggesting that many experienced farmers were in the sample.

According to data on household income, 66.8% of households make their living from agricultural pursuits. Nonetheless, social grants were reported as a source of income by 68.8% of households. Just 3.6% of respondents said they were employed, compared to 96.4% who said they were not employed. In addition, 94.8% of those surveyed said they did not engage in any business-related activity. According to the statistics, 68.4% of farmers owning the land they farm on, demonstrating the importance of land ownership in farming. Most respondents (95.6%) did not lease their land to third parties.

Additionally, 28% of the respondents engaged in communal farming. According to the findings, 73.2% of the participants do not belong to any farming associations. Regarding how products are sold, roadside stands account for 36.4% of sales, while processing companies account for 26.8%. A sizable percentage of respondents (29.6%) did not sell their produce, which could mean they are subsistence farmers or have trouble getting their produce to markets. The study also found that 59.6% of respondents processed their maize. However, only 1.2% of respondents own processing equipment, indicating a reliance on outsourced processing services. According to the findings, 66.4% of respondents had no access to markets, and 89.6% had no access to credit.

Respondents suggested measures to improve the food security situation for smallholder farmers. Those measures include education and training (9.6%), improved farm visits (5.2%), equipment (14.4%), extension support (74.8%), access to many hectares of land (2.8%), and access to water (45.6%). however, 46.8% of respondents sometimes have access to adequate food.

Additionally, the findings indicate that, with a coefficient of age and access to credit, it was statistically significant at the 5% significant level, and they had a negative relationship with food security status. Moreover, the study also uncovered that effective extension services and access to the market had a negative relationship with food security status, and they were significant at a 1% level. The income level and land size were statistically significant at 5% but positively related to food security status. This study investigated the

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factors influencing food security among smallholder farmers in South Africa. The results show that 32.4% of population lives below poverty line. The study also identified significant relationships between food security and variables such as age, income level, and efficacy of extension services, land size, market accessibility, and access to credit.

5.2. Conclusion and recommendations

The study highlighted the critical role of agricultural extension services in enhancing food security among smallholder maize farmers in Makhado Municipality. The findings show that the majority of farmers are older, have limited formal employment, and rely heavily on agriculture and social grants as their primary income sources. Furthermore, reliance on outsourced maize processing services due to a lack of personal processing equipment limits value addition and income generation. Structural barriers such as inadequate land access, water scarcity, and limited training opportunities were identified as critical constraints to achieving sustainable food security. Additionally, limited access to extension services exacerbated the constraints posed by inadequate land access and water scarcity. Strengthening extension services could help address these structural barriers and improve food security outcomes. Despite these challenges, the respondents acknowledged the importance of extension support, with 74.8% suggesting its enhancement as a measure to improve their situation.

32.4% of the respondents lived below the poverty line, and the average income shortfall was 13.28% among the poor. The findings underscore that younger farmers are more food secure than older farmers are because of their ability to adopt innovative practices and technologies. Income positively influences food security, with higher earnings enabling households to invest in quality food and agricultural inputs. Conversely, limited access to credit significantly reduced food security, as farmers struggled to invest in essential resources such as seeds and fertilisers. Similarly, inadequate market access negatively affects food security by restricting farmers' ability to sell produce efficiently, reducing income and food availability. Ineffective agricultural extension services make food insecurity worse by preventing farmers from using optimal practices and by not offering timely, useful advice. Additionally, a larger land size enhances food security by enabling crop diversification and economies of scale, but land access remains a challenge

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for many smallholder farmers. The findings highlight the complexities of food insecurity among smallholder farmers in South Africa. The results suggest that addressing food insecurity requires a multifaceted approach that takes into account the interplay between demographic, economic, and institutional factors. Policymakers and stakeholders should prioritise interventions that enhance the efficacy of extension services, improve market accessibility, and increase access to credit for smallholder farmers.

The study recommends strengthening AES by increasing the frequency of farm visits and providing targeted training programs focused on modern farming techniques, climate-smart practices, and value addition. Access to market should be encouraged to farmers and services to improve the quality of crops should be provided to improve market access for smallholder farmers. Initiatives that provide affordable credit options for smallholder farmers, such as microfinance programs or agricultural insurance schemes should be implemented.

5.3. Areas for Further Studies

The study suggests the following:

- Effectiveness of agricultural insurance programs: Evaluation of the impact of agricultural insurance programs on food security among smallholder farmers in South Africa.
- Influence of social networks on food security: Investigate the role of social networks in enhancing food security among smallholder farmers in South Africa.

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APPENDIX

Appendix A: Questionnaires

Assessment of the Effectiveness of Agricultural Extension Services in Enhancing Food Security among Smallholder Maize Farmers in Makhado Local Municipality, Limpopo Province, South Africa

Dear respondents,

I am Munyai Trevor from the University of Venda under the Faculty of Science, Engineering, and Agriculture, Department of Agricultural Economics and Agribusiness. I am here to conduct a research on effectiveness of agricultural extension services in enhancing food security among smallholder maize farmers in Makhado local municipality. Your input is important to assess the effectiveness of AES in enhancing food security among smallholder maize farmers in Makhado local municipality. Your responses are greatly appreciated and will be kept **strictly confidential.**

INSTRUCTION: Please feel free to answer all the questions honestly by filling the provided spaces and marking the relevant boxes with [X].

Your input is highly valued. Thank you

1. GENERAL INFORMATION

1.1. Date of the interview ……

SECTION A

1. SOCIOECONOMIC CHARACTERISTICS OF RESPONDENTS

1.1. What is your gender?

Male	Female

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1.2. What is your age in years? ----------

1.3. What is your race

Black African	White	Coloured	Indian

1.4. What is your marital status?

Single	Married	Divorced	Widow

1.5. What is your educational attainment?

No formal education	Primary education	Secondary education	Tertiary education	Abet

1.6. Years of formal education? ----------

1.7. What is your occupation status?

Employed	Unemployed	Self employed

1.8. Are you a full-time farmer? i. Yes [ ] ii. No [ ]

1.9. What is your farming experience in maize farming? ----------

1.10. Source of household income

Agricultural activities	Salaried Employed	Business	Social grant	Others (specify)

1.11. Main occupation: ----------

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1.12. What is your total income per month in maize farming (Rand): ----------

1.13. How much do you spend buying food per month

1.14. Do you own the land? i. Yes [ ] ii. No [ ]

1.15. If the answer to question 2.14 is no, what type of arrangement exists between you and the land owner?

Lease	Communal	Others (specify)

1.16. What size is the land in hectares? ----------

1.17. Do you belong to any Farmer's organization? i. Yes [ ] ii. No [ ]

1.18. Which organizations do you belong to?

AgriSA	
DALRRD	
Transvaal Agricultural Union	
Others (specify)	
None	

1.19. What is your selling method?

Processing Company	Roadside Stand	Farmers' market	Export	Others (specify)

1.20. Do you process maize? i. Yes [ ] ii. No [ ]

1.21. Do you have a processing machine? I. yes [ ] ii. No [ ]

1.22. Do you pay for processing? i. Yes [ ] ii. No [ ]

1.23. Is maize produced for consumption, selling, or both? .....

1.24. Do you have access to the market? i. Yes [ ] ii. No [ ]

1.25. Do you have access to credit? i. Yes [ ] ii. No [ ]

SECTION B

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2. SERVICE RENDERED BY THE EXTENSION AND THEIR EFFECTIVENESS

Services Rendered by extension officers	Very Ineffective (1)	Ineffective (2)	Average (3)	Effective (4)	Very Effective (5)
1. Assist in identifying the problem					
2. Assist in overcoming the problem					
3. Introduce new technologies					
4. Create opportunities for farmers? (e.g. Marketing, processing, etc.)					
5. Help farmers to put new information into use					
6. Provide advice to the farmers					
7. Provide maize management					
8. Provide workshops for farmers					
9. Provide formal training to farmers					
10. Provide production inputs					
11. Visit the farm for identification of the problem					
12. Provide technical services (e.g. seeds and soil testing services)					
13. Provide farming knowledge and education					
14. Assist in setting up the price of the product					
15. Help on how to deal with weed management					

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16. Assist with cultivation practices					
17. Advice about plant protection against climate change					
18. Bring solution toward climate change					
19. Advice on plant protection					
20. Assist farmers with water management					
21. Organize group meetings for farmers					
22. Visit the farm					

SECTION C

3. FOOD SECURITY STATUS OF SMALLHOLDER FARMERS

3.1. How many hectares of the land you cultivate maize?

.....

3.2. What is your average annual maize yield in kilograms?

.....

3.3. How much do you earn per month from maize farming in Rand? .....

3.4. How much do you spend on food?

.....

3.5. Number of people in the household?

.....

3.6. Do you and your family always have food? .....

3.7. Do you have access to healthy food? ……

3.8. Have you experienced any difficulties in accessing food in the past months/years?

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i. Yes [ ] ii. No [ ]

If yes, please specify

……

……

3.9. Do you face food shortage at home sometimes?

i. Yes [ ] ii. No [ ]

3.10. What strategies do you employ during periods of food scarcity?

Borrowing Food	Reducing portion sizes	Changing eating patterns	Others (specify)

3.11. Have you received any support or interventions from government or non-government organizations to improve food security? i. Yes [ ] ii. No [ ]

If yes, please specify

……

……

……

3.12. What measure do you think could improve the food security situation for smallholder farmers in your area?

.....

.....

.....

.....

.....

3.13. How often do you and your family have access to an adequate amount of food?

Always	Often	sometimes	rarely	Never

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SECTION D

4. Maize farmers' perception of AES and food security

Maize Farmers' perception of AES and food security	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. AES contribute to economic growth and job creation					
2. Agricultural extension has a role in poverty reduction					
3. Agricultural extensions are the pillars of agricultural development and food security					
4. Agricultural extensions have a positive economic impact on food security					
5. Agricultural extension reduces farm operating costs					
6. Agricultural extension services lead to generation of greater profits					
7. Agricultural extension services improve agricultural production					
8. Agricultural extension services help farmers' access to the market					
9. Agricultural extension service improves farming practices					

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Appendix B: Covering letter

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16 September 2024

TO WHOM IT MAY CONCERN

This serves to introduce **Ms Travor Munyai (Student Number: 18019814)**, an MSc student under my supervision in the Department of Agricultural Economics and Agribusiness, University of Venda, South Africa, to you.

She is currently conducting a study titled **''Assessment of the Effectiveness of Agricultural Extension Services in Enhancing Food Security among Smallholder Maize Farmers in In Makhado Local Municipality, Limpopo Province South Africa''**.

Your kind assistance is required in assisting with Data collection for her Dissertation by introducing her to the smallholder farmers in your domain and availing her we whatever she might need during the course of this exercise.

Feel free to contact me for any additional information that might be needed using my details on this letter.

Thank you for your cooperation and support in making the exercise hitch free.

Yours sincerely.

Prof IB Oluwatayo

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