TOWARDS DEVELOPING A PLURALISTIC AGRICULTURAL EXTENSION SYSTEM: THE CASE OF VHEMBE DISTRICT OF LIMPOPO PROVINCE, SOUTH AFRICA

BY

RUDZANI VHUYELWANI ANGEL MUDZIELWANA

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PREFACE

The research work described in this thesis was carried out in the School of Agriculture, Earth and Environmental Sciences (SAEES), University of KwaZulu-Natal, Pietermaritzburg, from March 2021 to December 2022, under the supervision of Prof. Paramu. L. Mafongoya (School of Agriculture, Earth and Environmental Sciences, University of KwaZulu Natal, South Africa) and Doctor Mutondwa M. Phophi.

I want to declare that the research work reported in this thesis has never been submitted in any form to any other university.

It represents my original work, except where due acknowledgements are made.

Candidate: Rudzani V.A Mudzielwana

Signed:  Date__01/12/2022_____

As the candidate's supervisor(s), I certify the above statement and have approved this thesis for submission.

Supervisor: Prof. Paramu. L. Mafongoya

Signed:  Date: __01/12/2022_____

Co-supervisor: Doctor Mutondwa M. Phophi

Signed  Date: ____01/12/2022_____

DECLARATION 1: PLAGARISM

I, **Rudzani Vhuyelwani Angel Mudzielwana**, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research,
2. This thesis has not been submitted for any degree or examination at any other university,
3. This thesis does not contain other persons' data, pictures, graphs, or other information unless expressly acknowledged as being sourced from other persons,
4. This thesis does not contain other persons' writing unless expressly acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
    a) Their words have been re-written, but the general information attributed to them has been referenced.
    b) Where their exact words have been used, then their writing has been placed in italics and inside quotation marks and referenced;
5. This thesis does not contain text, graphics, or tables copied and pasted from the Internet unless expressly acknowledged, and the source is detailed in the thesis and the References section.

Signed:  _____ Date:01/12/2022_____

DECLARATION 2: PUBLICATIONS AND MANUSCRIPTS

1. **Mudzielwana, R.V.A [1], Paramu, P.L [2], Phophi, M.M [3], Mngomezulu, S.P. [4]**. 2022. Towards developing a pluralistic extension system in South Africa. *Journal of Agricultural Education and Extension.* [Under Review]. Manuscript ID:

DEDICATION

To my Grandmother Vho-Tshinakaho Johanna Kwinda and Vho- Nkhukhuna Nora Mutakusi, thank you so much for encouraging me to continue going to school, I love you to the moon and back.

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To my parents (Mr Mudzielwana Ofhani and Mrs Mudzielwana Cynthia) and my siblings (Mudzielwana Gabriel and Mudzielwana Zwonaka), thank you for your support and for keeping me in your prayers.

I thank you to the government officials from the Department of Agriculture in Vhembe District, the Deputy Minister of Thulamela Municipality and stakeholders that participated in this study.

I acknowledge Professor Paramu Mafongoya for his financial assistance towards this research. This research would have been challenging to complete without his help.

ABSTRACT

Agricultural extension is a crucial component of agricultural development, food security improvement and rural livelihood enhancement. However, many farmers are constrained by extension systems that are difficult to access or lack quality services that utilise modern approaches, technologies and training methods. The rationale of this study is to look at the efforts to define and disseminate good practices, strategies and approaches to establish efficient agricultural extension services. This study used a quantitative research design to collect data from 319 respondents. A multiple linear regression model analysed factors influencing smallholder farmers' performance under pluralistic and non-pluralistic settings. The study findings indicated that credit access ($p<0.05$), access to public extension ($p<0.1$), extension feedback ($p<0.01$) and transparency and accountability ($p<0.05$) negatively influenced the performance of the smallholder farmers in the study area. A binary probit regression model was used to analyse factors influencing the perception of implementing a pluralistic extension service providers system among smallholder farmers. The findings from the study indicated that age ($p<0.05$) negatively influenced the probability of implementing a pluralistic extension system among smallholder farmers in the study area. The binary probit regression model was used to analyse the determinants of smallholder farmers' willingness to pay for extension services. The study's findings indicated that marital status ($p<0.1$) negatively influenced the probability of smallholder farmers' willingness to pay for extension services in the study area. The multinomial logistic regression model was used to analyse factors influencing a sustainable extension service system among smallholder farmers. The farm size ($p<0.1$), extension feedback length ($p<0.01$), and effectiveness of extension ($p<0.1$) negatively influenced a sustainable extension service system among smallholder farmers in the study area. Gender ($p<0.1$), household size ($p<0.1$), willing to pay for extension service ($p<0.01$), the difference in output ($p<0.1$) and annual income ($p<0.01$) positively influenced a sustainable extension service system among smallholder farmers in the study area. The study encourages collaborations among public and private stakeholders, researchers, extension officers and rural development agencies to implement a cost-effective pluralistic extension system that meets the end users' or clients' (smallholder farmers) agricultural/ farming needs.

Keywords: Pluralism, smallholder farmers, Collins Chabane Municipality, Thulamela Municipality

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

APP	Abalimi Phambili Program
CLM	Collins Chabane Local Municipality
CCSR	Centre for Census and Survey Research
DFID	Department for International Development
FGDs	Focus Group Discussions
GTZ	German Technical Cooperation
GDP	Gross Domestic Product
HSSREC	Humanities and Social Sciences Research Ethics Committee
ICT	Information and Communication Technology
ME	Marginal effects
NDP	National Development Plan
NGOs	Non-Governmental Organisations
ANOVA	One-Way Analysis of Variance
OLS	Ordinary least squares
DBSA	Southern African Development Bank
SPSS	Statistical Package for Social Scientists
SSA	Sub-Saharan Africa
LRDF	The Lima Rural Development Foundation
T&V	Training and Visit
TOT	Transfer of Technology
VIF	Variance Inflation Factor

CHAPTER 1. INTRODUCTION

1.1 Background

The primary role of the agricultural sector in South Africa is to provide food and employment, improve livelihoods and ensure that natural resources are protected (Greyling *et al.,* 2015). The agricultural sector alleviates poverty, hunger, and unemployment in disadvantaged areas by implementing rural development projects. In Limpopo Province in Vhembe District, agriculture is practised by both smallholder farmers and commercial farmers (Maponya, 2021). Vhembe district is one of the high-potential agricultural areas of the province (Mpandeli, 2014; Maponya, 2021). About 90% of rural communities in the Vhembe district depend mainly on agriculture to sustain their livelihoods and generate income (Maponya, 2021). Most farmers in Limpopo Province practice farming in about 1.53 ha to 20 ha (Chauke et al., 2014). Crop production in Vhembe District is also a key livelihood diversification strategy that provides most rural households with food and income (Mulaudzi et al., 2019). Most farmers in Vhembe District grow their crops on trial and error through the utilisation of local indigenous knowledge (Nethononda and Odhiambo, 2011). Farmers in this district, including Tshakhuma, Rabali and Tshiombo areas, produce subtropical and tropical crops (Mpandeli, 2014; Maponya, 2021). In the Tshakhuma area, about 70% of the farmers cultivate perennial crops such as avocado, with about 18% producing bananas, groundnuts, maise and cowpea (Mpandeli, 2014; Maponya, 2021). In Limpopo province, in areas such as Tshakhuma and Levubu, avocado and banana crops are usually grown in those areas favoured by good climatic and soil conditions (Mpandeli, 2014; Maponya, 2021). Levubu farmers, who are farming on the eastern side of Makhado, assist Tshakhuma farmers in accessing banana seedlings. Approximately Less than 8% of the farmers in the Tshakhuma area produce cabbages, and another 4% of the farmers produce seasonal vegetables such as onions, carrots, lettuce and cabbage (Mpandeli, 2014; Maponya, 2021). In the Tshiombo area, less than 10% of the farmers plant bananas, avocados and cabbage, while 88% of the farmers produce varieties of crops, such as sweet potatoes and tomatoes (Maponya, 2021).

An agricultural extension service is a standard tool the Provincial Department of Agriculture uses to transfer meaningful agricultural knowledge and information and train new techniques to farmers and various stakeholders (Zwane et al., 2014). Agricultural extension has been a

long-term key informer worldwide, with about 90% of public extension agents assisting agricultural stakeholders and smallholder farmers in rural areas (Norton and Alwang, 2020). Agricultural extension remains an effective rural development strategy because it enables smallholder farmers to identify their agricultural challenges and find desirable solutions to their problems (Maoba, 2016).

An extension officer is an advisor who serves as a middleman between agricultural research institutions and farmers. They provide technical advice to farmers (both animal and crop production farmers), such as pest control strategies or methods, agricultural farming practices, and identifying potential markets for their produce (Shemfe and Oladele, 2018). In South Africa, disseminating information is an essential source that ensures that extension services are rendered to the end-user (farmers) because information influences a farmer's decision towards their agribusiness (Oladele et al., 2019). Therefore, ensuring an extension officer provides a demand-driven service is vital to building credibility and trust with the farmers (Oladele *et al.*, 2019).

The agricultural development strategies have changed over time. Various extension approaches have evolved from a traditional technology transfer and farm management information delivered by the public sector to an expanded public and private advisory service (Norton and Alwang, 2020). Traditional technology transfer models, characterised by top-down, linear, and rigid approaches, were criticised in various studies for their poor performance on farmers' output production and failure to recognise the impact on their socio-economic characteristics and other factors affecting smallholder farmers (Taye, 2013).

The South African government has reduced its investments in agricultural extension services to farmers due to bureaucratic inefficiencies (Norton and Alwang, 2020). The limited governmental funding in South Africa has led to poor service delivery, affecting the performance between extension providers and smallholder farmers. Therefore, agricultural extension systems have evolved and become more pluralistic over the past years by depending on other delivery mechanisms and funding sources. (Norton and Alwang, 2020).

Sectors involved in the existence of a pluralistic extension service provider are the public sector (state agencies), private sector (farm households, agribusiness enterprise) and mixed extension system sector (non-governmental and non-profit organisations) that source from diverse

funding sources (Davis and Terblanche, 2016). The benefits of pluralistic advisory services have been forecasted to have the ability to overcome financial constrain and extension services and provide the necessary needs of a specific region (Birner *et al*., 2009). In extension service, models are ubiquitous in many African countries such as Kenya, Zimbabwe, Ethiopia and South Africa, and these models are defined by a delivery approach (supply or demand, top-down or participatory), the providers (public or private) and the funding sources (public, private or development agency). The changes in the models previously used to recognise the inherited diversified farmers and farming systems in models have illustrated that extension is experiencing a scientific revolution that may likely be caused by the evidence that the existing models are ineffective as they should be (Norton and Alwang, 2020).

1.2 The conceptual framework of the study

This study draws its conceptual framework from Birner et al. (2009) in their publication, "From Best Practice to Best Fit", which can be used nationally and internationally to evaluate pluralistic agricultural advisory services. The framework for designing and analysing pluralistic agricultural advisory services was developed through a collaboration among various research institutions at the national and international levels as a practical approach to assessing pluralistic agricultural advisory services worldwide.

Figure 1.1 is a graphical representation of the conceptual framework for designing and analysing agricultural advisory services. The framework serves to assist policymakers with nominating several reformation ways. Furthermore, this framework separates agricultural extension services by pointing out a difference between government structures, capacity management and extension services methods and suggests the utilisation of an impact chain approach whereby the performance and impact of agricultural extension services, theoretical discussions and actual research methods that can be used when applying the framework (Birner et al., 2009). The framework is of great significance to the study as it assesses the tools used by the agricultural extension service provider when to process the reformation of extension service and guide inter-disciplinary future researchers.

As indicated in Figure 1, the framework follows what contextual factors should be considered initially, such as the policy environment, the capacity of potential service providers and partners, production system and market access and the community aspects. The contextual

factors influence how agricultural extension services should be structured and organised by identifying the characteristics of agricultural advisory or extension services, such as governance structures, capacity, management and their advisory or extension methods. The agricultural extension performance is determined by the quality of the service provided to the clients, such as farming households. However, the ultimate empirical impact of agricultural extension services depends on the actual change of the farming households when exercising their demanded services.

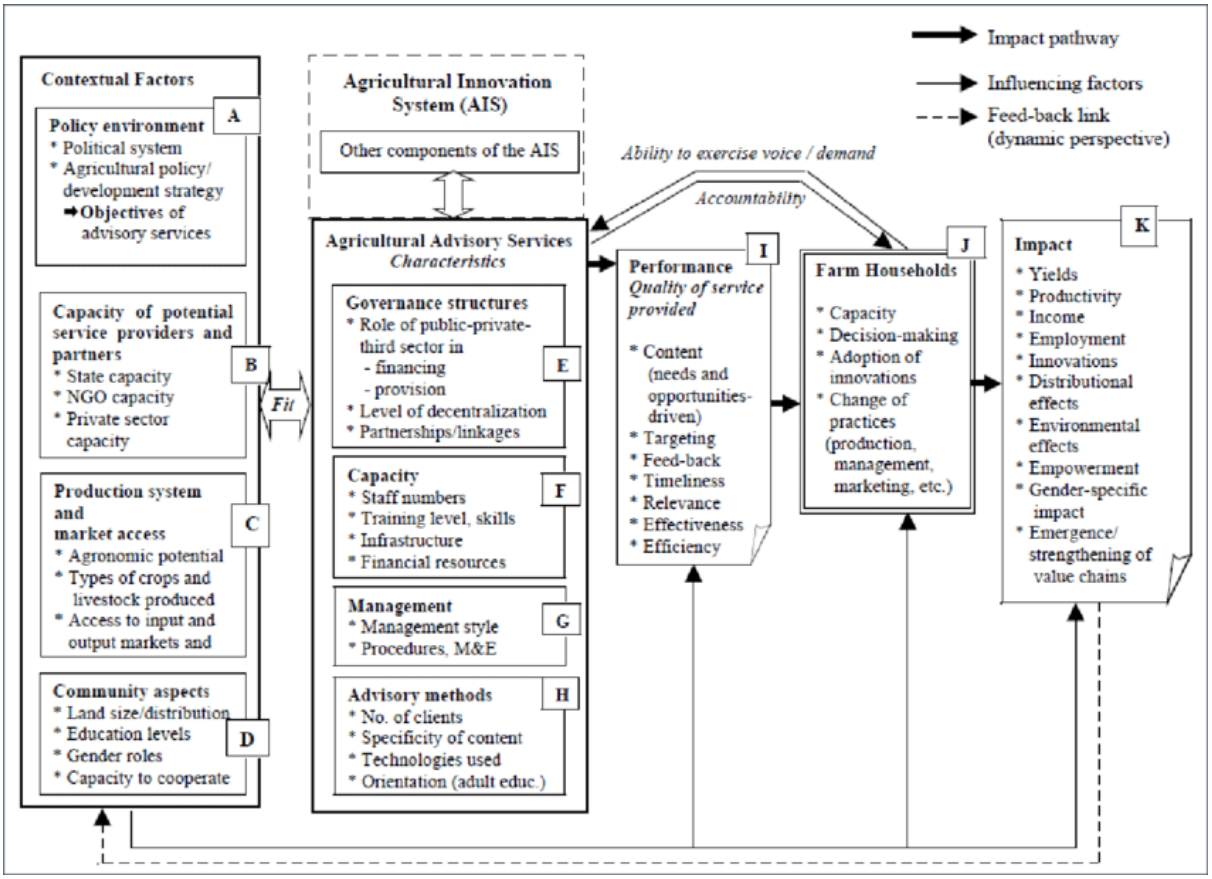

Figure 1.1:The conceptual framework for the design analysis of agricultural extension services.

Source: Birner *et al.* (2009)

The relevant variables (Boxes A to D) alter over time due to variables such as joint macroeconomic advancement and macro-political alter, particular approach intercessions (e.g., speculation in framework), and unintended impacts (e.g., climate change and natural asset debasement). Giving agrarian admonitory administrations may be an arrangement mediation

that points to altering these variables. Boxes I, J, and K of Figure 1 can be translated as an effect chain. Utilising the phrasing of effect chains, the execution pointers (Box I) allude to the quality of the yields of an admonitory benefit. These yields lead to quick changes in farmers' conduct (Box J), middle outcomes benefits at the cultivated family level, and affect broader societal objectives (Box K).

One can characterise many executions (Box I) markers to capture the quality of admonitory administrations. These pointers depend on the advisory service's objectives and are best recognised in a participatory way, including policymakers, benefit suppliers and clients. For case, they may allude to the (1) exactness and pertinence of the substance of the counsel, (2) opportuneness and outreach of the exhortation, (3) quality of the associations built up and the input impacts made, (4) effectiveness of benefit conveyance and other financial execution pointers.

The farm households (Box J) are central to the conceptual system. Any effect that advisory administrations can accomplish concerning extreme advancement destinations depends on how the clients utilise the benefit. Vitally, as demonstrated by the bolts in Figure 1, the capacity of agriculturists to work out voice and define requests is of vital significance for the execution of rural admonitory administrations. This capacity impacted characteristics that cultivate family units, communities in which they live (Box D), and the characteristics of the admonitory benefit.

For illustration, a decentralised administration structure (Box E), an excellent advisory staff-to-farmer proportion (Box F), a responsive administration approach (Box G), and the utilisation of participatory admonitory strategies (Box H) are all variables that progress the conceivable outcomes of cultivate families to work out voice and hold the benefits suppliers responsible. Within the early stages of moving towards a demand-driven approach, suppliers may confront a weak demand and consequently have to be, to begin constructing the capacity of ranchers to specify their request.

From a policy perspective, the ultimate criterion for assessing agricultural advisory services is their impact (Box J) concerning the policy objectives the advisory services set up to achieve.

1.3 Problem statement

Agricultural extension strategies are vital in developing countries (Davis and Terblanche, 2016). However, minimum evidence still guides extension service providers on the choice of reform options (Birner *et al*., 2009). The public-sector research and extension systems in South Africa are assigned to deliver public goods and services to farming groups (Raidimi and Kabiti, 2017). As much as the agricultural extension services reach large farming groups, the mixed extension system in Vhembe District (public and private extension service) lacks resources that address problems encountered by smallholder farmers. In addition, the costs incurred during the association with farm visits and individual face-to-face interaction have resulted in limited transportation availability and extension service provider staff (Steinke *et al*., 2020).

The extension has become broad, with more holistic approaches being implemented to ensure that the services provided are demanded by clients such as farmers and other agricultural food systems (Davis, 2019). Initially, the extension was influenced by a linear transfer of technology approach (Koutsouris, 2018; Davis, 2019). The approach assumed that extension officers would transfer the new technologies to farmers (Koutsouris, 2018; Davis, 2019). However, during the process, farmers' indigenous local knowledge was neglected. As a result, the approach was perceived as an ineffective extension approach (Koutsouris, 2018; Davis, 2019). Therefore, there is a need for an extended shift to more participatory, farmer-led and demand-driven models, whereby farmers' empirical knowledge and experience are valued.

The limitations have resulted in extension service providers giving generic advice to a diverse farming population, thus affecting the poorest of farmers and spatially remote households (Taylor and Bhasme, 2018). According to Davis (2008), research activities do not often align with the information that farmers and extension officers need due to the agricultural research and agricultural extension being carried out by separate organisations. For instance, research may consider the publication output, while extension services follow a specific technology transfer agenda (Davis, 2008).

The difference in governance between extension officers and smallholder farmers hinders the much-needed transition from the most linear to systematic approaches in disseminating

information (Davis, 2008). Therefore, to maintain an approachable and effective agricultural extension service, the public extension should find alternative resources to provide and finance agricultural extension services (Raidimi and Kabiti, 2017). Based on the assumed important role that extension officers play in improving smallholder farmers' livelihood, this study will evaluate the impact of implanting a demand-driven pluralist extension system service in the Vhembe District of Limpopo Province, South Africa.

1.4 Justification

South African extension services have not reformed to new approaches that are more pluralistic, which may lead to improved agricultural services provided by extension officers (Kau et al., 2019). Most studies have focused on the public extension officers being the sole extension and advisory services providers. However, there is limited knowledge or studies on the contribution of private extension officers providing extension and advisory services to smallholder farmers in South Africa (Raidimi and Kabiti, 2017).

Agricultural extension in South Africa, just like most third-world nations, is lacking in the accreditation of sources of agricultural information, hence, among others, an appropriate method of assessment and evaluation of the academic, capabilities and skills qualifications of agricultural extension officers is required. Service end-users (farmers) have emphasised the need for the accreditation of professional advisors and consultants in South Africa (Zwane, 2014).

In South Africa, pluralistic extension services exist, implying that both public and private extension service providers should provide to the end-users (farmers). However, the quality of these service providers varies significantly because of training and educational background differences, as well as exposure to clients or farmers. As a result, some service providers' quality and standard of services have been described as below standard in terms of effectiveness and efficiency (Zwane, 2014). Chassin et al. (2010) suggest that a socially rendered public service should acquire specific standards to be considered a quality service deliverer. These standards should be measurable and verifiable and include the capability of meeting the needs of end-users or target beneficiaries.

A study of this nature has been conducted in countries such as Malawi, Kenya, Ethiopia, Ghana, Benin, Mali, Mozambique, Nigeria, and Zambia, which have reformed their traditional extension services that are demand-driven and are well adopted at a national level (Kau et al., 2019). The reformation of traditional extension services has proven effective and financially efficient. Therefore, there is a need to address the knowledge gap on the effectiveness of the pluralistic agricultural approach in the extension services of Limpopo Province, Vhembe District.

1.5 Research questions

Given the above problem, this study aims to provide answers to the following research questions:

i. What constraints are the public extension system currently experiencing?

ii. What is the knowledge and perception of smallholder farmers moving from a public agricultural extension service provider to a pluralistic agricultural extension service provider?

iii. To what extent are smallholder farmers willing to change from public to private extension services?

iv. Can a pluralistic extension system approach be more efficient and financially sustainable for the smallholder farmers and address the abovementioned constraints in (1.)?

1.6 Research objectives

The study's general objective is to determine the main constraints to providing pluralistic extension services. The specific objectives are to:

i. To evaluate the impact of public agricultural extension service delivery on smallholder farmers' performance.

ii. To examine the knowledge and perception of implementing a pluralistic extension system among smallholder farmers.

iii. To analyse the determinants of smallholder farmers' willingness to change from public to private extension services.

iv. To identify factors that make extension service systems financially viable for smallholder farmers.

1.7 Research hypothesis

I. The type of agricultural extension service delivery system influences the performance of smallholder farmers.

II. Implementing a pluralistic extension system influences the general knowledge and perception of extension services that smallholder farmers have.

III. The willingness of smallholder farmers to reform public extension services influences the implementation of a pluralistic extension system.

IV. The pluralistic extension service provider is more efficient and financially sustainable for providing services to farmers than the public.

1.8 Study area

The study was conducted in South Africa, Limpopo Province, in the Vhembe District (Figure 1.2). The Vhembe District was established in the year 2000 concerning the terms of the local government municipal structures Act No. 117 of 1998 (Mufungizi et al., 2020). Vhembe district is the northernmost district municipality of Limpopo province, South Africa. It lies approximately between 22°08’ and 23°24’ latitudes and 28°54’ and 31°05’ longitudes (Odhiambo and Magandini, 2008). The Vhembe District consists of four local municipalities: Collins Chabane municipality (22.5108°S, 30.8039°E), Makhado municipality (23.0462°S, 29.9047°E), Musina municipality (22.3953°S, 29.6963°E) and Thulamela municipality (22.8922°S, 30.6200°E). The Vhembe District shares borders with the Capricorn Mopani

District Municipalities, Zimbabwe and Botswana in the North West and Mozambique in the south-east through the Kruger National Park (Kom et al., 2020; Mufungizi *et al*., 2020). The District covers 21 407 square km, of which 249 757 hectares are considered arable land. A subtropical climate characterises the Vhembe District. Its temperatures range from a minimum of 10ºC during winter to a maximum of 40ºC in summer, with an annual rainfall of approximately 500mm, of which 87.1% falls between October and March (Kom *et al.*, 2020*)*. The district's soil is variable, tending to be sandy in the west but with a higher loam and clay content toward the east. The soils are mainly developed on basalt, sandstone and biotite gneiss and generally have low inherent soil fertility. The smallholder farms are located primarily in the former homeland areas. Farming under a smallholder system is characterised by a low production level and small farm sizes of approximately 1.5 hectares, with production primarily for subsistence and a slight marketable surplus (Odhiambo and Magandini, 2008).

The agricultural system in the Vhembe District is characterised by two types: large-scale commercial farming and smallholder farmers, with sweet potatoes, beans, vegetables, maise, tomatoes, and pumpkins as commonly grown vegetables (Kom *et al.*, 2020*)*. Due to budget constraints, this study only focused on Collins Chabane Municipality and Thulamela Municipality. Following the local elections held on August 3, 2016, the Collins Chabane Local Municipality (CCLM) was created following Section 12 of the Municipal Structures Act (No. 117 of 1998). In the Vhembe District, the municipality is now the fourth Local Municipality (Category B). It shares boundaries with Musina in the north, Thulamela in the northeast, the Mopani District in the south, and Makhado in the west. It is located in the northern region of the province of Limpopo. The region comprising the municipal area, which has a total area of 5 467.216 km2, was formerly a part of the Thulamela and Makhado Local Municipality (Nyahunda and Tirivangasi, 2022). Thulamela municipality is situated in the eastern subtropical region of the province (Luvhimbi et al., 2022). The municipality is predominantly rural, with a few formal towns and large villages with a significant concentration of smallholder farmers and economic activities centred on Thohoyandou town (Lidzhegu and Kabanda, 2022).

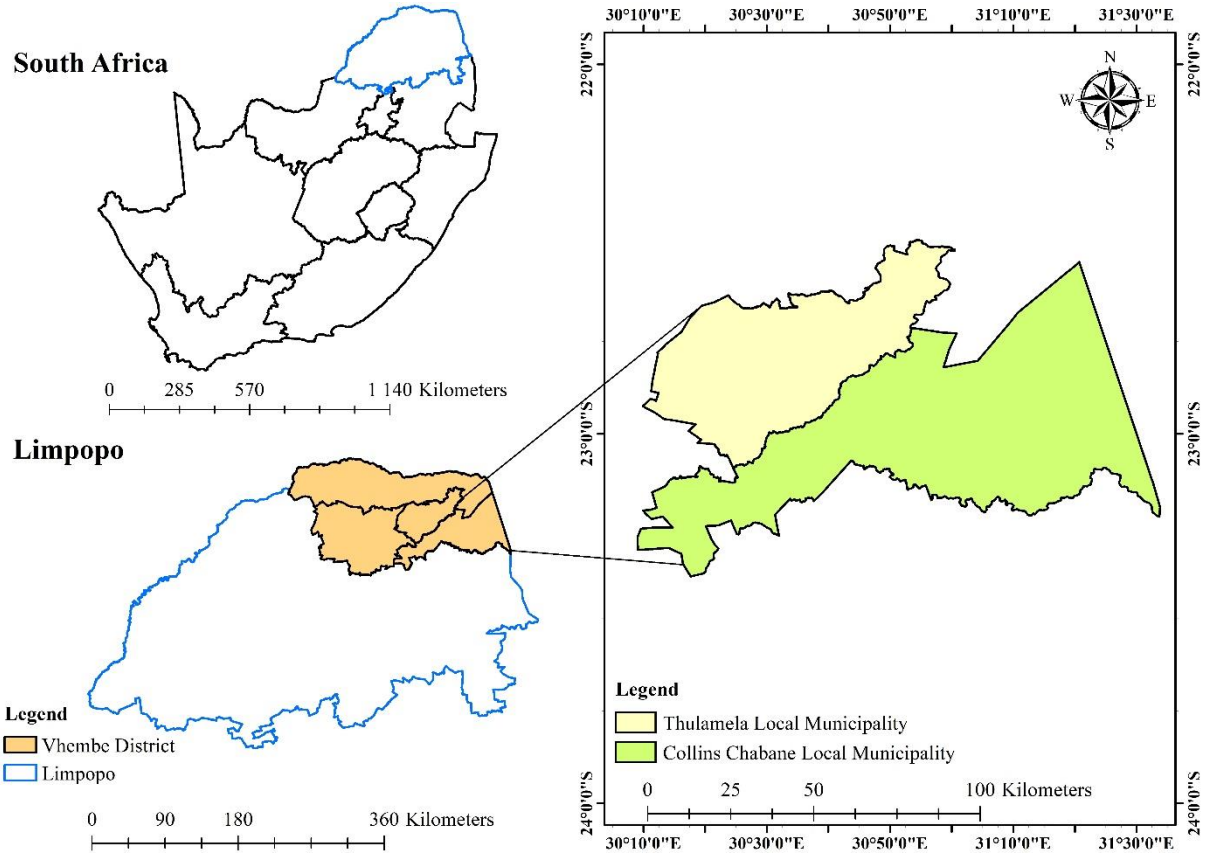

Figure 1.2: Study site, Vhembe District, Limpopo Province (Source: Author).

1.9 Ethical consideration

The study was performed per the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments and approved by the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of KwaZulu-Natal (protocol reference number: HSSREC 00003210/2021). Accordingly, the Department of Agriculture in the Vhembe District of Limpopo Province granted permission to conduct the study in Thulamela Municipality and Collins Chabane Municipality in 2022.

1.10 Thesis presentation

The dissertation was organised into seven chapters and can be read independently from the thesis, but each paper is linked and contributes to this study's overall aim and objectives. **Chapter 1** discussed the introduction, problem statement, study justification, research questions, research objectives, research hypothesis, the study area and the ethical consideration.

Chapter 2 reviews the existing literature relevant to agricultural extension reformation study and lastly the chapter highlights the knowledge gaps while providing direction for future research. **Chapter 3** evaluates factors affecting smallholder farmers' performance: a Vhembe District, South Africa case. **Chapter 4** present factors influencing the perception of implementing a pluralistic extension system in Vhembe District, South Africa. **Chapter 5** evaluates the willingness of smallholder farmers to pay for extension services in Vhembe District, South Africa. **Chapter 6** determines factors influencing a sustainable extension service system among smallholder farmers in Vhembe District, South Africa. **Finally, chapter 7** presents the significant findings identified in the study and recommendations to inform future research.

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CHAPTER 2 LITERATURE REVIEW

A REVIEW OF DEVELOPING A PLURALISTIC PUBLIC EXTENSION SYSTEM IN SOUTH AFRICA

ABSTRACT

This chapter reflected on efforts to define and disseminate practices, strategies and approaches to establish efficient, effective and financially stable agricultural extension services. The agricultural extension has become broad, with more holistic approaches being implemented to ensure that the services provided are demanded by clients such as farmers and other agricultural food systems. Initially, the extension was influenced by a linear transfer of technology approach. The approach assumed that extension officers would transfer the new technologies to farmers. The approach was perceived as an ineffective extension approach. The approach used to review the literature on modernising agricultural extension is to transform and modernise the extension system to play a more vital, more enhanced role in increasing farm income and enhancing the livelihoods of the rural poor**.** The findings identified that weak extension services limit the ability for potentially beneficial agricultural innovation and market opportunities to reach smallholder farmers in South Africa. This study concluded that before reforming the agricultural extension system, the reformation of the agricultural extension system should have a clear understanding of the needs of the farmers they provide extension services to. The practical implication is that the chapter concludes with a call for studies to evaluate its impact on the performance of smallholder farmers they seek to serve, to inform policies about its need, impact and effectiveness. Sustainable agricultural development can be achieved by applying extension approaches and models that are considered appropriate for smallholder farmers' needs, increasing farmers' basic knowledge and ability to make their own sound choice of specific technologies.

Keywords: Agriculture extension reformation; agricultural advisory services; smallholder farmers; contracting-out.

2.1 Introduction

The agricultural sector in Africa remains the main viable driver for economic development and sustaining livelihoods (Fatty et al., 2021). Agricultural production contributes about 30 percent of sub-Saharan Africa's Gross Domestic Product (GDP). About 4 million South African farmers are engaged in smallholder and commercial farming. The state is mainly responsible for the agricultural extension delivery of services to end users through the department of agriculture (Baiyegunhi et al., 2019). Smallholder farmers in most developing countries depend on rain-fed agriculture for household food production and income (Kyambo et al., 2021). An agricultural extension allows smallholder farmers to adopt desirable changes in farming practices (Madan et al., 2021). It also addresses the issues that sabotage the smallholder farmers' and communities' quality of life and rural livelihoods. Therefore, the agricultural extension could be viewed as a middleman to poverty reduction (Madan et al., 2021). Therefore, the agricultural extension can be defined as a " structured entity with organisations that facilitate and support farmers and communities involved in agricultural activities to eradicate farming challenges and obtain feasible information, skills and technologies to improve their well-being" (Kassem et al., 2021).

However, agricultural extension is undergoing unrestrained changes around the world (Davidson, 2007). The trend towards the privatisation of the public agricultural sector due to services rendered to farmers by public extension officers raises many questions about whether the public agricultural extension is feasible to stand on its own. Pluralism extension recognises the difference between smallholder and commercial farming communities. Pluralism extension service recognises the need for diversity in extension service delivery systems (Davidson, 2007). The public sector carries out these activities, private sector and Non-Governmental Organisations (NGOs) to meet the diverse needs of farmers with varying social arrangements, and living in diverse locations. The possible reasons for the involvement of various actors in agricultural extension include scarce government funds, removal of agricultural subsidies, structural adjustment reforms, withdrawal of public extension from the provision of inputs, inadequate extension coverage, and expansion of market and recurrence of crop and livestock diseases (Davidson, 2007). Coordination among the various agencies is, therefore, a prime challenge. Failure to provide extension services to end users can have catastrophic consequences, affecting the lives of farmers and their families and the credibility of farmers'

advisory services (Davidson, 2007). The term “agricultural extension” in this review is being replaced by the term “agricultural advisory” to focus beyond the role of technology transfer (Kassem et al., 2021). Therefore, this study used the initial term “agricultural extension”. This review reflects on agricultural extension in South Africa and the direction of future research with smallholder farmers.

2.2 Reflection on agricultural extension in developing countries of Sub-Saharan Africa

Africa is globally known as the primary source of agricultural raw materials used by manufacturing and processing companies, contributing about 40% to the export of goods and services. In contrast, about 60% to 80% of the population in the continent relies on agriculture as their primary source of income to sustain their livelihoods (Agholor, 2019).

According to the Inter Academy Council (IAC) (2004), Africa is where, because of famine, disease, and a growing population, almost 200 million people are undernourished, and 33 million children go to sleep malnourished and hungry every night. The production in the agricultural sector in Sub-Saharan Africa (SSA) can potentially reduce poverty (Bjornlund et al., 2020). With the exclusion of crude oil exportation from Nigeria, the food crisis has been persistent. The food crisis is more damaging in the African region, thus affecting almost 36 countries in Sub-Saharan Africa (Bjornlund et al., 2020). This situation is caused by several factors, including low levels of mechanisation, inadequate use of fertilisers, inadequate access to improved seeds, reliance on rain-fed agriculture, inadequate water management and climate change factors (Abdu-Raheem and Worth, 2016).

The agricultural extension structural trends are changing in Sub-Saharan Africa. These extension structures are changing due to decentralisation, privatisation and urbanisation (Abdu-Raheem and Worth, 2016). For instance, in countries such as Rwanda, Tanzania and Uganda, agricultural extension has had more influence on the local agricultural district, with the ministers of agriculture having little input on what is being done at the district level (Bjornlund et al., 2020). Zimbabwe once used a similar method, however, it was removed from the system in 1970 due to the dissatisfaction from field extension staff (Abdu-Raheem and Worth, 2016, Bjornlund et al., 2020). This occurred because the extension officers in Zimbabwe were being supervised at a district level by non-governmental professionals. On the other hand, in countries

such as Tanzania and Ethiopia, the agriculture ministers took account of extension services at the district level through their regional offices (Abdu-Raheem and Worth, 2016, Bjornlund et al., 2020).

Implementing and adapting a pluralistic system in SSA have given farmers a chance to enjoy the nomination of various services rendered to them. The broadened collection of services given to farmers through a pluralistic approach results in the added value quality of the services that are provided to farmers (Bjornlund et al., 2020). However, the pluralistic approach or system has resulted in the governments minimising their involvement in agricultural extension activities. Agricultural extension activities in SSA will continue to need support from the government if significant crucial services such as responding to tragedies, risk-bearing sharing, regulation of the system, quality control of the services rendered to farmers and promotion of reform, regardless of the type of institution (public sector, private sector or other) that are providing the agricultural services to the end users (farmers) (Abdu-Raheem and Worth, 2016, Mutimba, 2014).

Decentralisation is used as another strategy for reforming extension. They have also implemented privatisation of extension services in which farmers share with the state responsibility for funding extension services. The most common use of decentralisation retains the public sector and public funding features of traditional centralised extension, however, it redistributes responsibility for extension delivery and relocates it to local, district, and or governments. However, there are crucial inherent challenges of decentralisation which result in; a lack of financial sustainability, the propensity to use extension agents for jobs outside their responsibilities and the trouble linking with research.

2.3 Agricultural pluralistic extension service in South Africa

The effectiveness of extension services continues to remain open to criticism (Carelsen, 2020). Since the beginning of 2008, the South African government invested in the agricultural public extension system to improve its effectiveness, while numerous studies investigated the efficiency and accountability of extension services (Carelsen, 2020). Agricultural extension services have been launched around the world as an institutional contribution to the

modernisation of agriculture and the promotion of rural development (Baiyegunhi et al., 2019). Providing extension services, information and knowledge, helps smallholder farmers to make agricultural-level decisions and improve access to tangible and intangible resources such as agricultural productivity and build farmer resilience (Aker, 2011, Baiyegunhi et al., 2019). Extension services also promote better technical choices and diversification of agricultural activities through awareness-raising, dissemination and training that contribute to increasing agricultural productivity and household income (Elias et al., 2013). Therefore, the availability of competent extension services is critical to the success of the farm (Davis and Terblanche, 2016). In addition, extension plays an important role in organising farmers into formal or informal groups to help them mobilise collective action and maximise their competitiveness in the domestic and international markets (Kassem et al., 2021).

In the past years, South African qualified extension service providers have been withdrawing from working with the public agricultural extension sector to assemble their own private consulting companies (Loki et al., 2021). Therefore, resulting in the existence of privatisation or pluralistic extension systems that offer extensive agricultural extension services to farmers across South Africa (Loki et al., 2021). Privatisation means that it varies from person to person. Privatisation involves the complete transfer of ownership from the government to a private company, which bears all costs and receives all benefits (Zwane, 2016). Possible reasons behind the delay in the spread of privatisation towards smallholder farmers could be due to the extension ratio to farmer coverage and most extension services are provided to smallholder farmers that have the means to pay for the agricultural services (Loki et al., 2021). There is a high level of literacy among the smallholder farmers, which can make it difficult for them to understand all the thoughts conveyed to them. Even after the idea is communicated, some farmers do not succeed in putting the idea into practice afterwards (Maoba, 2016).

The opposite could be said about the commercial farmers in South Africa, whereby the private sector has managed to make a vast contribution. Regardless of the notion of reforming the public agricultural extension sector, a debate may be centred on whether it would be wise to privatise agricultural extension in South Africa where the smallholder sector is most dominant (Lyne et al., 2018). There is very little to no originated observed information regarding the impact of pluralistic extension services rendered to smallholder farmers in South

Africa and about the costs and benefits of these services. Such significant information is lacking in South Africa and calls for a need for future research.

2.3.1 The efficiency and accountability of extension services providers supporting smallholder farmers

Smallholder farmers play a significant role in the agricultural sector with the majority of these farmers being the primary producers of most of the crops they grow (Raidimi and Kabiti, 2019). The agricultural sector in South Africa plays a fundamental role in economic growth, job creation and mitigation of food insecurity (Baiyegunhi et al., 2019). Although extension services transfer information to farmers about livestock and cropping techniques, for instance, which inputs to use and how to utilise them first-hand, extension services in South Africa face major challenges in the areas of significance, efficiency and accountability of the type of services rendered to farmers (Loki et al., 2021). In South Africa, the National Development Plan (NDP) and its Vision 2030 provide institutional support such as advice and counselling to support resource-poor farmers' to land, and water and institutional support such as extension and advisory services as a means of supporting rural economies and alleviating poverty (Baiyegunhi et al., 2019, Loki et al., 2021). However, despite the positive attempt to institutionalise a participatory extension system in South Africa and the increase in public expenditure on agriculture, its impact in ensuring equality of farmers in the essence of racial and gender representation, access to land, inputs and agricultural information services have not been reporting anticipated outstanding feedback (Baiyegunhi et al., 2019, Loki et al., 2021).

Furthermore, in South Africa, similar to other developing countries, the government, through the Department of Agriculture, is mainly responsible for agricultural extension service delivery to farmers (Black and Gerwel, 2014). These extension services are provided free of charge as social welfare, which makes the government bear all the costs (Loki et al., 2021). However, only a small percentage of these smallholder farmers receive any type of extension support (Aliber and Hall, 2012). In particular, the state's extension services face the following challenges such as having to facilitate land reform, obtaining financial support and creating sufficient initiatives that focus on the development of the smallholder farmer (Baiyegunhi *et al*., 2019)

Among the many other challenges in agricultural development for smallholders, are poor land management practices, limited access to factors of production, credit and information, and high transaction costs for input and product markets stemming from poor rural infrastructures (Baiyegunhi et al., 2019). Smallholder farmers are often marginalised politically. In addition, the support for agricultural activities is often urban-based. Smallholder farmers are located in remote rural areas characterised by poor infrastructure, making it extremely difficult for them to access the essential resources, information, training, technology, capital and assets essential for agricultural production (Abebaw and Haile, 2013). Smallholders are vulnerable to risks and uncertainties due to a lack of information on weather, inputs, management practices and markets (Baiyegunhi et al., 2019, Loki et al., 2021).

Limited funding for expansion has made the agricultural sector difficult and has resulted in poor performance that directly impacts the performance of smallholder farmers (Loki et al., 2021). In addition, inadequate financing entails some of the challenges currently facing the agricultural extension and or advisory sector (Baiyegunhi et al., 2019, Loki et al., 2021). Farmers who receive extension services with equipped use updated information may reduce production and market risks. Therefore, the availability of competent extension services would potentially be a principle to the success of South African agribusiness sector (Davis and Terblanche, 2016).

2.4 Contracting out agricultural extension programmes in South Africa

Due to state or government in improving the agricultural productivity of smallholder farmers, the involvement of non-governmental organisations (NGOs) in providing expansion has been advocated (Baiyegunhi et al., 2019, Lyne et al., 2018). This has led to a shift involving private NGOs, the semi-private sector and advocacy groups to support multidimensional advisory services to address the information needs of smallholder farmers. The Lima Rural Development Foundation (LRDF) is a great example of change. The Lima Rural Development Foundation is a non-governmental, non-profit organisation that serves farmers in rural areas (Baiyegunhi et al., 2019, Lyne et al., 2018). Since 2002, through the Abalimi Phambili (APP) program, it has provided a variety of agricultural support services to smallholders in many areas or districts of Eastern Cape and KwaZulu-Natal. The support services provided by LRDF include the provision of agricultural information, advice and training, linking smallholder farmers to input,

credit, machinery and product markets. These services are collectively referred to as Lima`s extension program (Baiyegunhi et al., 2019).

The Lima Rural Development Foundation targets districts that are well-suited to agriculture and places a technically qualified facilitator in each of its field sites. Local program activities are generally driven by the facilitator`s interaction with committed farmers and farmer groups (Carelsen, 2020). The APP was initially funded by the South African mining industry. In 2005, the program was awarded by the ComMark Trust and expanded to include two projects funded by the UK Department for International Development (DFID). Although these projects were completed in 2009, Lima continued its rural development efforts, funded by a mining company and more recently the Southern African Development Bank (DBSA) (Lyne et al., 2018). Lima APP's independent assessments were conducted between 2008 and 2009, but none of these assessments provided a reliable quantitative assessment of the impact of the program.

A few studies have focused on the assessment of private pluralistic extension services in South Africa. Given the participation of NGO's stakeholders in addressing the information need of farmers, it is, therefore, necessary for studies to evaluate its impact on the performance of smallholder farmers they seek to serve, in order to inform policies about its need, impact and effectiveness.

2.5 Agricultural extension approach

To provide productive and effective advisory services, the pluralism of extension approach is utilised in developing countries due to the diverse needs of farmers, production systems and agricultural policy objectives (Mapiye et al., 2021). The agricultural extension approach and models can only be effective with the provision of efficient extension mechanisms that can be easily accessed by farmers (Akinnagbe and Ajayi, 2010). The main extension approaches and models that have been used in the continent of Africa include the transfer of technology approaches, training and visit extension approach commodity specialised approaches and cost-sharing approaches. With a focus on experiences from Africa, the following section provides a historical and descriptive summation of each of these approaches (Mapiye et al., 2021).

2.5.1 Technology Transfer-Based Extension Approach

Traditionally, the view of technology transfer is a top-down approach based on researchers producing innovative advisory services. The transfer technologies that are generated at research stations are then passed to extension officers and later passed to farmers (Batchelor et al., 2014). Around the turn of the 19th century, colonialism and imperialism gradually introduced various agricultural innovations, and most of them were agricultural technologies that had a limited impact on farmers (Birner et al., 2006). During this period, the link between research, extension and farmers in Africa was frail, creating gaps in the dissemination of modern technology research results. However, the great development of agricultural science has allowed public and private research institutions to create more non-agricultural technologies (Mapiye et al., 2021). This has given rise to technology transfer-based extension approaches that involve top-down planning, with a focus on disseminating initiatives to farmers (Akpalu, 2013).

2.5.1.1 The Training and Visit (T&V) Extension Approach

The training and visit extension model was instigated in Turkey in the 1970s and later acknowledged in Africa under the supervision of World Bank sponsorship between the late 1970s and 1980s (Eicher, 2007). The T&V approach was developed with a focus on transferring information and technology through extension officers and farming stakeholders (Marwa et al., 2020). The benefit of utilising the T&V approach is that through advanced farmer training, extension officers can become more knowledgeable and be up to date with information and technology needed by the farmers. The T&V strengthened research extension linkages by ensuring that research is relatable to the needs of smallholder farmers (Akinnagbe and Ajayi, 2010). Other benefits include numerous regular farmer visits and a more professional approach to the provision of extension by the extension staff, which ultimately improves the quality of services provided to the end users (Mapiye et al., 2021). In Kenya, the T&V approach offered staff training and improved extension linkage with researchers (Akinnagbe and Ajayi, 2010). However, the T&V model was set back financially, as it consumed about three billion dollars over a short period. Therefore, failing in meeting the needs of farmers due to high expenses and high coverage ratio of farmers of extension officers (Marwa et al., 2020). Regardless of the financial attack, South Africa continued using the

approach and had to initiate various modifications to improve the effectiveness of the system (Mapiye et al., 2021).

2.5.2 The Commodity Specialized Extension Approach

The commodity-specialised extension approach has been in existence since the colonial era and is currently implemented in various African countries (Mapiye et al., 2021). The approach could be defined as an extension approach that manages to place different activities in order of importance (Kidane and Worth, 2016). The commodity-specialised extension approach production function includes technology extension, research, provision of input, producing marketing and pricing under one organisation structure or administration (Kidane and Worth, 2016). The commodity-specialised extension approach is classified as a self-financed research and extension system structure by coordinating with the public sector. The commodity system has a holistic engagement with private firms that produce and market significant cash crops (Kidane and Worth, 2016). Furthermore, the commodity extension system research has been receiving strong and successful support from private firms. For instance, in South Africa and Zimbabwe, the engagement with private firms has led to the establishment of some successfully developed out-grower schemes for commodities such as vegetables, tobacco, sugar cane, and dairy cattle (Mapiye et al., 2021). However, although the approach combines research and extension systems, this approach has a reputation for applied pressure due to poor performance in certain areas. Its basis is in the interest of companies than smallholder farmers. Therefore results in a poor understanding of whole farm system challenges, and opportunities for smallholder farmers which ultimately leads to food shortages (Mapiye et al., 2020).

2.5.3 The Cost-Sharing and Education Institution Approach

The cost-sharing sharing model and approach that combines a government and farmer partnership at national and local levels is considered one of the most sustainable reforms in delivering extension services because of its ability to generate funding that can support its effective organization (Mapiye et al., 2021). The cost-sharing sharing model and approach implement the mix of public-private sector participation in financing agricultural extension. Stakeholders can contribute any amount as this is determined by a country's extension system

circumstances, the prevailing socioeconomic environments, the nature of agricultural production, and any other external factors (Ozor et al., 2021). The approach assumes that non-formal extension educational programs are more likely to achieve the intended goals if the farmers share the costs amongst themselves (Mapiye et al., 2021). The approach further assumes that rural farmers cannot afford the total cost of accessing extension services, therefore central and regional governments should cover part of the cost. The willingness and ability of farmers to contribute to costs individually or through local governments are often used as a measure of the success of this approach (Mapiye et al., 2021).

Ethiopia began adopting a cost-sharing model in the late 2000s. For example, the farmer training centre has been set up at the local government level to serve five villages and small farmers from 750 to 1500. Farmers donated 3-6 acres of community land to build a farmer training centre, including a demonstration farm, and the government paid for the construction of the centre. Farmers also contributed by providing free labour to build these facilities (Davis and Terblanche, 2016, Mapiye et al., 2021). However, cost-sharing models and approaches are not well accepted in the majority of developing countries (Davis and Terblanche, 2016, Mapiye et al., 2021). In Nigeria, funding for extension services is chronically underfunded. Government contributions are always well below budget, hindering the proper implementation of an efficient extension system (Ozor et al., 2021). This approach can be frustrating for the government since it does not allow the government to control the program or the staff running the program. This is exacerbated when the state contributes no cost.

2.5.4 Ministry based or Public Extension Approach

Many nations in Africa and Asia adopted the ministry-based extension strategy, also known as the public extension approach, which has historically been the most prevalent extension system globally (Eicher, 2007; Raidimi, E., and Kabiti, 2019; Mapiye et al., 2021). Since agriculture is a state topic, central governments typically bear the primary responsibility for agricultural extension activities (Mapiye et al., 2021). The technology transfer strategy is primarily supply-driven, efficiency-based, and focused on particular national goals, like raising yield and lowering production costs for domestic goods (Swanson and Rajalahti, 2010). Supporters of this approach believe that the Ministry of Agriculture is solely responsible for planning and managing extension (Mapiye et al., 2021). Normally, farmers and the government exchange

information is usually facilitated through a uniform and nationwide organizational pattern as prescribed by the national policy (Mapiye et al., 2021).

The approach's fundamental premise is that the Ministry of Agriculture has valuable information and technology that the farmers aren't taking advantage of (Mapiye et al., 2021). The improvement of the farmers' families and increases in the output of national commodities serve as indicators of the strategy's effectiveness (Mapiye et al., 2021). The government's ability to use the public extension method to execute national agricultural policies and development programs for smallholder farmers is one of its main benefits (Mapiye et al., 2021). Farmers can visit the extension offices at any time to get information and guidance under the ministry-based extension program (Mapiye et al., 2020). However, the approach has been constantly under pressure for its poor performance and the lack of two-way flow of information between extension staff and farmers (Mapiye et al., 2020).

The principal-agent setup plagues the method constantly, it is expensive, and as a result, investment in Africa and Asia has generally decreased (Millar, 2009). The public extension system also has institutional inefficiencies linked to bureaucratic procedures, a lack of responsibility, and subpar transdisciplinary arrangements, according to FAO (2017). In addition to these elements, a dearth of technological interventions, such as the application of ICT-based innovations, may be to blame for the approach's subpar performance (David, M.M. and Samuel, 2014). According to reports, the public expansion strategy is employed in a number of African nations, including Ethiopia, Tanzania, Malawi, Botswana, Senegal, and Zimbabwe, as well as Asian nations, including China, Indonesia, and India (Swanson and Rajalahti, 2010).

The National Agriculture and Livestock Extension Plan (NALEP), which was launched in Kenya in 2000, is being carried out by the Ministries of Agriculture and Livestock and Fisheries Development. According to the NALEP internal assessment reported by Cuellar et al. in 2006, up to 80% of the beneficiary farmers agreed that the program's implementation had given them new and beneficial possibilities. The NALEP strategy, according to more than 70% of the farmers, convinced them to view farming as a business rather than a means of subsistence. Further, the Ministry-based extension strategy was effectively used in Zimbabwe to promote the rapid adoption and use of hybrid maize varieties and fertilizers, and the program doubled

smallholder maize output in that country in six years, from 1980 to 1986 (Eicher, 1995; Mapiye et al., 2021).

2.5.5 The Farmer Field School Approach

The Farmers Field School (FFS), which originated in Asia and was effectively implemented there to teach farmers about integrated pest management through farmer group learning, was introduced to Africa (Feder, 2004). Because it is participative and employs a non-formal education strategy where extension employees serve more as facilitators than instructors, the strategy is well-liked in these areas (Feder et al., 2004). To improve the creation and transfer of invention, the method is group-based and employs iterative and interactive adult learning practices that involve regular meetings (e.g., weekly or monthly) that adhere to a set timetable, observations, and experiential learning (Anandajayasekeram, 2007). Farmers receive assistance during the meetings to conduct their study, analyze and try farm problems, and create suitable solutions for the problems (Kaur et al., 2018). The basic premise behind the FFS approach is that all initial facilitators will possess a high level of expertise and will be adequately equipped to implement farmer group learning for the development of farmer capacity. It also presumes that producers are already very knowledgeable (Anandajayasekeram, 2007).

One benefit of the FFS approach is that it relies more on farmers' observations and reflections than on extension workers, who typically make general suggestions. Additionally, it is helpful in educating farmers about complex, specialist topics like sustainable natural resource management (Swanson and Rajalahti, 2010). The FFS approach's main drawbacks are that it has a relatively high implementation cost, requires a lot of work, and only targets a small number of farmers who are interested (Abadu-raheem and Worth, 2016). The participatory FFS method, if not carefully led, can have a negative impact on community benefits, claim Abadu-raheem and Worth (2016). The reason for this is that solely relying on farmer demands may lead to the provision of exclusive technology or services, which are frequently of short-term importance to the farming community as they could be suggested without taking the longer-term externalities, such as environmental degradation, into consideration.

Numerous African nations, including the Democratic Republic of the Congo, Gambia, Niger, Cameroon, Togo, Uganda, Namibia, Tanzania, Nigeria, and Zimbabwe, have adopted the FFS strategy. FFS has helped participants' attitudes and perceptions change, according to evidence from the five case studies conducted in ESA countries (Anandajayasekeram, 2007). It has also aided in the formation of new connections between farmers, researchers, extension agents, and community development professionals. However, the research and extension staff's insufficient exposure to the ideas and practices of the approach severely hindered its implementation in the majority of the ESA countries. According to a research conducted in Cameroon by Wandji et al. (2008), farmers who participated in the FFS were significantly more knowledgeable about crop husbandry techniques than those who did not. FFS was found to have had a significant effect on younger farmers, female-headed households, and those with low literacy levels, in addition to having a significant impact on farmer productivity and income in studies carried out in Kenya, Tanzania, and Uganda (Davis et al., 2012).

2.5.6 The Farming Systems Research–Extension Approach

The goal of the farming systems research-extension (FSR-E) strategy is to help farmers by developing and delivering technology in a holistic, systems-based, localized, and iterative manner (Kaur et al., 2018). Experiences in Africa, Asia, and Latin America served as the foundation for the early iterations of this strategy, which were led by economists and social scientists (Bingen and Gibbon, 2012). Prescriptive agricultural development models had previously failed (Mapiye et al., 2012). Since they couldn't take into consideration the objectives, socioeconomic situation, and agro ecological conditions of smallholder producers, agricultural extension strategies frequently failed (Mapiye etal., 2012). The FSR-E approach seeks to create practices that are specifically designed to completely satisfy the varied demands of the farmers. The FSRE approach's main premise is that local innovation can be used to develop technology that meets the needs of farmers, especially smallholder farmers (Mapiye et al., 2012).

As a result, the content for agricultural extension must be developed outside of research stations through on-farm study procedures involving neighborhood farmers and their farms (Bingen and Gibbon, 2012). The degree to which farmers embrace the technologies developed by the program and continue using them over time is used to determine the approach's success (Bingen

and Gibbon, 2012). The primary benefit of the FSR-E method is that it first offers a model for comprehending the difficulties and limitations that farmers face and how they deal with them (Mapiye et al., 2012). As a result, research scientists and extensionists create their programs through a knowledge of the needs of farmers rather than through prescriptions (Mapiye et al., 2012). In Zimbabwe, where it was promoted by the Farming Systems Research Section under the Department of Research and Specialist Services (DR and SS), the FSR-E was well established (Mapiye et al., 2021). At the local level, the Department of Agricultural Technical and Extension Services (AGRITEX) was the one that was more visible and involved in identifying farmers and overseeing on-farm trials (Mapiye et al., 2021).

2.6 Reformation of extension systems in developing countries

Failure by the public extension system to effectively support the ever-expanding smallholder livestock sector calls for innovative strategies to revolutionize the system. The privatisation of extension services in agriculture is an international issue that has been the focus of much discussion and research for over 30 years (Nettle et al., 2018). In many African countries, extension and advisory services have evolved and comprise public, non-profit and private sector players who constitute an important part of the agricultural value chain (Nwafor et al., 2021). While many agricultural development initiatives are experimenting with various forms of private extension and advisory services, the rationale for private extension services hinges on the overwhelmed public agricultural extension sector, inadequate funding and policy focus (Nwafor et al., 2021). Unsupported reforms in advisory and extension arrangements are suggested as a key cause of problems in extension and advisory systems, resulting in fragmentation in services. This has resulted in calls for the government to play a continued role in supporting a diversity of options and services for farmers and in the alignment of services (Nettle et al., 2018).

2.6.1 Reformation of pluralistic agricultural extension services models and approach in developing countries

Smallholder farmers have experienced challenges in acquiring effective and reliable agricultural information due to the identified limitations of the agricultural extension models and approach (Marwa et al., 2020). This has resulted in the majority of smallholder farmers in

developing countries, worldwide producing minimum farm output (Marwa et al., 2020). To meet the needs of the affected smallholder farmers, more effective extension services approaches and models are needed to be implemented to curb these challenges. For instance, before the revolution of extension approaches or technologies, smallholder farmers were struggling to benefit from them. (Tata and McNamara, 2016). In addition, smallholder farmers could not reach or had miscommunications with most of their customers for selling their products at good prices and tracking medical expenditure on their livestock as well as expenditure on farm chemicals to receive sound information from other stakeholders (Chhachhar et al., 2014).

In response to address these problems, agricultural experts and institutions are globally promoting the implementation of the use of Information and Communication Technology (ICT) through education agents and agricultural extension to improve the knowledge and skills of individuals in rural areas (Tata and McNamara, 2016) (Figure 2.1) below demonstrates the potential of incorporating agricultural approaches and models with the Information and Communication Technology (ICT) for the sustainable growth of smallholder farmers systems. Information and Communication Technology (ICT) are devices (i.e., cell phones) and tools (i.e., the internet) that enables the exchange or collection of data via a transaction or transmission. ICT is used as a middleman between these three parties, namely; extension, research and farmers (Marwa et al., 2020).

ICT can be a medium through which information on new research findings can be communicated to extension workers by the research institutions for onward communication to farmers. Also, farmers can use the same ICT platform to communicate feedback on the new technologies from their field experiences to the extension workers for a relay to the research institutions for appropriate action (Nyarko and Kozári, 2021). Furthermore, ICT has the means of creating a platform (WhatsApp or Facebook group) that will have farmers, extension workers, and researchers on board to share valuable information for a rapid response, which will help break the weak linkage between these three parties (Nyarko and Kozári, 2021). Developing countries in Africa are adapting to the use of phones and the internet to bring a revolution to the public extension system in support of smallholder farmers (Mapiye et al., 2021).

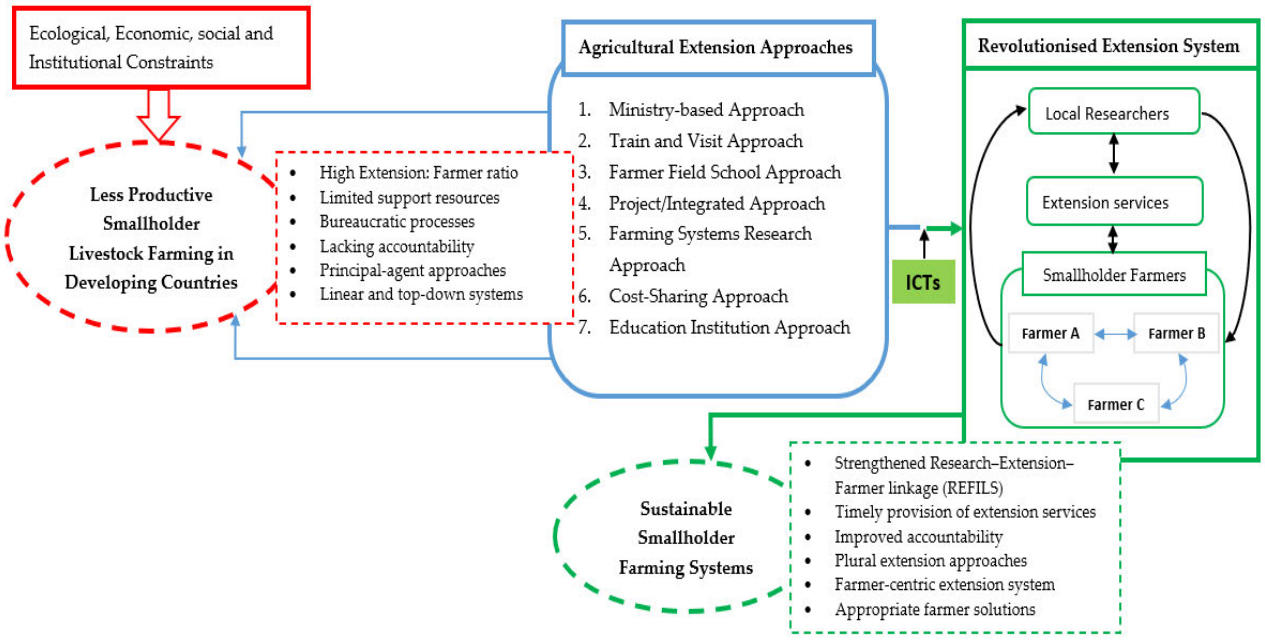

Figure 2.1:The graphic presentation on the prospects of reforming agricultural extension approaches using information and communication technologies (ICTs) Source:(Mapiye et al., 2021).

Radio has brought changes in unique sectors of society. Radio is still a present paramount medium of communication in decentralizing agricultural programmes and the latest information to farmers (Chhachhar et al., 2014). However, developing countries in Africa are faced with the critical problem of accessing electricity in rural areas. Farmers and other communities who mostly depend on radio spectrum features to meet their needs for information regarding education, health, agricultural news and weather information turn to miss these significant programmes (Chhachhar et al., 2014).

In the process of agricultural extension modernization, mobile phones are emerging as vital applicant tools of ICT. In SSA, the evolving ICTs and the use of mobile phones have progressively moved beyond mere communications. The adoption of mobile internet for SSA is about 24% and it is expected to continue growing (Mapiye et al., 2021). An agricultural profiling messaging service called Esoko was established in 2005 in Ghana. Esoko offers marketing, livestock, and crop production advice and weather forecasting to smallholder farmers. It has since been replicated and operates in 16 African countries including Nigeria, Sudan, Malawi, Kenya, Uganda, Rwanda, and Zimbabwe and will be expected to grow globally in 2050 (Ameyaw, 2015). In addition, farmers can easily utilize the ICT platform (WhatsApp

or Facebook group) to communicate their feedback regarding their field technology experience to the extension officers for a relay to the research institutions for suitable action. Mobile cell phones are considered a valuable advancement as they are a form of present and future agricultural extension technologies (Nyarko and Kozári, 2021). Therefore, to support the adoption of ICTs in developing countries, an effective agricultural extension policy agenda and active involvement of government agencies with various other agricultural institutions would be required.

2.7 The significance of strengthening agricultural extension services through a pluralistic extension system in developing countries

There is a growing need for food, energy and fibre provided by natural resource-based systems to meet the needs of a growing world population while addressing climate change and resource degradation. This may also require a radically different food system (Klerkx, 2020). Despite the ageing and declining rural population, the issue of farming system succession is fundamentally universal (Klerkx, 2020). Pluralistic extension contributes to recognizing the inherent differences that exist between farmers and farming systems and the need to address challenges in agriculture development with different approaches (Klerkx, 2020). In many developing African countries (Nigeria, Ethiopia, Kenya and Zimbabwe), the public sector is no longer the sole source of delivering agricultural services to farmers. The provision of agricultural extension services is characterized by multiple providers of the sources and with more actors who finance the services provided (Gemo et al., 2013). It is valuable to differentiate the sectors that are potentially involved in financing and providing agricultural extension services. Table 2.. Presents options for providing and financing agricultural extension: (a) the public sector (public administration, state agencies), (b) the private sector (farm households, agribusiness enterprises, other profit-oriented firms), and (c) the third sector (non-governmental and non-profit organizations, farmers' organizations, civil society organizations) (Birner et al., 2009).

Table 2.1:Options for Providing and Financing Agricultural Extension

Source of Finance for the Service					
Provider of the service	**Public sector**	**Private sector: Farmers**	**Private sector: Companies**	**Third sector: NGOs**	**Third sector: FBOs**
Public sector:	(1) Public sector advisory services (different degrees of decentralization)	(5) Fee-based public sector advisory services	(9) Private companies contract staff from public sector advisory services	(12) NGOs contract staff from public sector advisory services	(16) FBOs contract staff from public sector advisory services
Private sector: Companies	(2) Publicly funded contracts to private service providers	(6) Private sector companies provide fee-based advisory services	(10) Embedded services: Companies provide information with input sale or marketing of products	(13) NGOs contract staff from private service providers	(17) FBOs contract staff from private service providers
Third sector: Nongovernmental organizations - NGOs	(3) Publicly funded contracts to NGO providers	(7) Advisory services agents hired by NGO, farmers pay fees	(11) Private companies contract NGO staff to provide advisory services	(14) NGOs hire own advisory staff and provide services free of charge	
Third sector: Farmer-based organizations (FBOs)	(4) Publicly funded contracts to FBO providers	(8) Advisory service staff hired by FBO, farmers pay fees		(15) NGO fund advisory service staff who are employed by FBO	(18) FBOs hire own advisory staff and provide services free to members

Source: (Birner et al., 2009).

However, Table 2.1 does not release an entire range of options for providing and financing agricultural extension services. As noted in the public sector of Table 2.1, there are various options regarding the amount of decentralization (Birner et al., 2009). In this instance, decentralization can take many forms, such as deconcentrating (with the action of accountability remaining within the Department of Agriculture), and devolution to local governments (accountability to locally elected governments). Agricultural extension services can be analysed amongst different cells in Table 2.1. For instance, the full privatization of a public sector advisory system is represented by a move from the cell (1) to cell (6), whereas reform strategies that involve contracting out are represented by moves from cell (1) to cells (2), (3) or (4). A substantial variety of different reform strategies has already been implemented in different developing African countries (Gemo et al., 2013). Farmers need to have access to effective and efficient extension services to increase their agricultural productivity. The experience of other countries such as Ghana, Mozambique, Malawi and South Africa displays that public extension is not enough to support the entire rural agricultural community (Ba Haghighat et al., 2019). A general reform trend has been seen in moving away from public sector models and approaches of providing and financing advisory services towards contracting out or privatization (Birner et al., 2009).

Privatization of agricultural services cannot fully replace public extension services, but serve the complementary public and private extension services that can balance each other. However, private extension providers should play a more active role in providing these services (Ba Haghighat et al., 2019, Birner et al., 2009). Private companies provide services under specific motivations and respond to farmers in terms of what they see as most profitable. Due to the constraints for instance accessing an efficient budget, any type of extension service provider (public-sector, private-private sector) needs to appoint the best mix of public, private and NGO services for its farmers (Ba Haghighat et al., 2019). The public sector as a whole has been overabundant in many agricultural extension activities, therefore, the transfer of some of them to the private sector could make possible the more effective implementation of essential services to farmers in developing countries (Norton and Alwang, 2020).

2.8 Directions for future research

- Very few African countries are consolidating their extension service systems through the application of a pluralistic extension system due to the constraints encountered in the public sector. Studies should be done on the impact of privatization when establishing methods of coordinating the quality of services provided to smallholder farmers in the extension system.
- The establishment of the methods developed through privatization in South Africa should also consider their technical staff or capacity to deliver the services.
- Studies should also consider the conditions of how should pluralism to extension workers operate efficiently. Information and communication technology has the potential to reform a public extension system.
- Future research should focus on information and communication technology in South Africa as an extension method approach. Where it can be appropriate, efficient and financially sustainable when addressing the constraints faced by rural smallholder farmers.

2.9 Conclusion

Agricultural extension in South Africa has been the primary source that provides farmers or people who are engaged in agricultural production. With solving their farming problems, obtaining valuable information, skills and improved technologies to sustain their livelihoods for decades. However, due to the bureaucratic process, under-resourced and lack of accountability of the public extension system, smallholder farmers have struggled to curb their daily challenges. This has resulted in smallholder farmers not improving their farming skills and producing less output. Sustainable agricultural development can be achieved by applying extension approaches and models that are considered appropriate for farmers' needs, increasing farmers' basic knowledge and ability to make their own sound choice of specific technologies.

In support of smallholder farmers, the implementation of Information and Communication Technology (ICT) such as mobile phones with the internet, calls for innovative strategies to reform the public extension system in rural farming communities. Poor

information and communication incentives often discourage extension workers from requesting feedback engagements with farmers. Therefore, effective distribution of ICT has the potential to return fast feedback containing information and knowledge from the research and extension sector that meet the needs of farmers. It is quite evident that the public sector cannot be an independent source of finance for the service and a provider on its own. There is a need of encompassing other sectors to provide efficient extension services to smallholder farmers. Therefore, the central government should consider withdrawing to see the quality of services that are being provided to farmers. This paper concluded that before the instigation of reforming agricultural extension systems in South Africa, the reformation of the agricultural extension system should have a clear understanding of the needs of the smallholder farmers in the agricultural sector for it to be successful. Therefore there is a need for future research on the impact of searching for new agricultural extension service delivery systems on smallholder farmers.

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CHAPTER 3 EVALUATING FACTORS AFFECTING SMALLHOLDER FARMERS' PERFORMANCE: A CASE OF VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA

ABSTRACT

Agricultural extension services were made available globally as an institutional component for advancing rural development and modernizing agriculture, aiming to improve the public sector extension performance. However, smallholder farmers in rural areas struggle to perform despite the importance of agriculture extension. Recent empirical literature to guide agricultural extension and rural development policymakers concerning the impact of smallholder farmer performance by implementing a pluralistic extension approach or system in the Vhembe District of Limpopo Province in South Africa is scarce.

This study provides evidence that was carried out to evaluate the impact of a privatised extension as a source of agricultural extension service delivery towards smallholder farmers' performance in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. Data were collected from 319 from a population size of 580 smallholder farmers through a probability sampling method involving a stratified and simple random sampling technique. The data were analysed using a multiple linear model. Among the variables considered in the multiple linear models, gender ($p<0.1$), credit access ($p<0.05$), access to public extension ($p<0.1$), access to privatised extension ($p<0.05$), extension feedback ($p<0.01$) and transparency and accountability ($p<0.05$) were found to influence the smallholder farmers performance significantly. Based on the findings, the public's ineffectiveness allowed private extension service providers to thrive. The study recommends that public and private stakeholders collaborate in addressing smallholder farmers' challenges to stimulate comprehensive economic growth, food security and advancement of rural livelihood for farming households.

Keywords: Income; private extension services; public extension services; Collins Chabane Municipality, Thulamela Municipality

3.1 Introduction

The public extension system is the most significant and most popular information source for smallholder farmers in developing countries (Raidimi and Kabiti, 2019; Mapiye et al., 2021). With the Ministries of Agriculture having a de facto monopoly on the provision of extension and consulting services, it is one of the government's key initiatives (Mapiye et al., 2021). Providing farmers with information, training, and advisory services is still crucial for improving agricultural output on a global scale (Olorunfemi and Oladele, 2021). "A system that facilitates the farmers' access to knowledge, information, and technologies, facilitates their interaction with partners in research, education, agribusiness, and other relevant institutions, and assists them in developing their own technical, organizational, and management skills and practices," according to the definition of extension (Omoro, 2015).

The agricultural extension, therefore, refers to the process of convincing rural residents to adopt better farming practices to increase crop and livestock yield (Kiara, 2011). The agricultural extension acts as a conduit between research facilities and farmers, giving information based on first-hand experience for additional study (Kiara, 2011). It is impossible to overstate the importance of extension services in boosting innovation uptake and performance. Access to technology and expertise for smallholder farmers is made possible by extension services. For this to happen, extension materials need to be refreshed regularly to reflect changes in technology and farmers' desires (Kiara, 2011).

Productivity growth in smallholder farm agriculture can be a key driver of economic development and poverty alleviation in developing countries (Hemming et al., 2018; Mapiye et al., 2021). Smallholder farmers, however, are frequently confronted with various difficulties, including erratic weather patterns, market risks, and restricted access to knowledge, technology, and financial services. Low productivity and low rates of market involvement are the outcomes of these limitations (Aliber and Hall, 2012; Mapiye et al., 2021). Therefore, a crucial policy concern for advancing rural development and poverty reduction is how to remove the main obstacles to smallholder farmers' access to information and markets. Agricultural extension services are the primary means through which the public sector supports knowledge diffusion and innovation in the smallholder farming sector in most developing countries (Mapiye et al., 2021). Traditionally, extension agents have either worked with chosen "model

farmers" who are then expected to function as information multipliers or have attempted to directly educate farmers about the best practices of agricultural production (Mapiye et al., 2021). However, the effectiveness of conventional extension methods has been constrained, either as a result of little finance and hence insufficient outreach or because the information was not adequately adapted to farmers' requirements Mapiye et al., 2021).

Several factors influence the performance of smallholder farmers. These factors are probably characterized by personal or household traits, farm features, and socioeconomic variables (Namyenya et al., 2022). According to research conducted by Sikul (2015) and Namyenya et al. (2022), performance increases with age. Older workers are more likely to have more experience and, as a result, more task expertise. Another personal trait that can affect success is the farming experience (Namyenya et al., 2022). Farmers that have more practical farming expertise do better. Exposure to experience leads to the development of knowledge and competence, improving performance (Namyenya et al., 2022). Babalola (2016) discovered that experience has a detrimental effect on performance, which the study attributed to management emphasizing educated personnel over experienced ones because many seasoned workers may not have had a college degree. Smallholder farmers have also been found to perform better when they receive education since it increases their knowledge, skills, and performance-oriented attitudes (Siswanto et al., 2019). According to a study by Kiros and Meshesha (2022), farmers' performance suffered as a result of having access to loans. Farming provides a significant portion of the income for many rural South African communities, which helps reduce poverty. However, smallholder farmers typically have scarce financial and nonfinancial resources. Due to their limited revenue and margins, poor farmers frequently borrow money to increase production.

To increase the output of crops and animals used for human consumption, credit is essential in the agricultural industry. Credit is a capital option to increase productivity in developing nations, where farmers typically have low agricultural production due to a lack of money. Gender disparities in agricultural productivity have severe implications for food and nutrition security as they can have a negative impact on the rural socioeconomic development of agrarian economies (Miriti et al., 2022). Due to patriarchal kinship patterns in which men typically have larger rights to assets, notably land ownership, there are gender discrepancies in agricultural production in sub-Saharan Africa (SSA), which skews power relationships between spouses

(Miriti et al., 2022). As a result, men have more control over access to, use of, and income from economic activities in the household, which reduces women's bargaining power. The marital status of agricultural households may also impact farmers' productivity because stable households can better focus on output than unstable ones (Ouko et al., 2022). In addition, due to the diversity of opinions within the family, married families can better make sensible judgments than single, divorced, or separated households (Ouko et al., 2022).

Abate et al. (2019) found that farmers' performance suffered due to their lack of access to extension services. The technical efficiency of farmers who received extension services was lower than those who did not. Farmers' productivity suffered as a result of market access. Farmers with access to market information were less technically proficient than those without it. This could result from farmers not receiving information promptly (Abate et al., 2019).

Several studies in Africa, e.g., Uganda (Namyenya et al., 2022) and Ethiopia (Kiros and Meshesha, 2022) and South Africa (Mwadzingeni et al., 2020), have assessed the performance of irrigation schemes, agricultural extension managers and the formal financial credit status among smallholder farmers in rural areas, respectfully. However, recent empirical literature to guide agricultural extension and rural development policymakers concerning the impact of smallholder farmer performance by implementing a privatised extension service in the Vhembe District of Limpopo Province in South Africa is scarce. Hence, this study evaluated the impact of the current agricultural extension service delivery source on smallholder farmers' performance in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The hypothesis was that the performance of smallholder farmers is influenced by the source of the agricultural extension service delivery system. To test our hypothesis, we used a T-test for continuous variables and a chi-square test for categorical variables to indicate the association between smallholder farmers' performance with different economic parameters. In addition, the multiple linear regression model was used to analyse factors influencing smallholder farmers' performance.

3.2 Materials and methods

3.2.1 Description of the study area

The study was conducted in South Africa, Limpopo Province, in the Vhembe District. The Vhembe District was established in 2000 concerning the terms of the local government municipal structures Act No. 117 of 1998 (Kom et al., 2020). Vhembe district is the northernmost district municipality of Limpopo province, South Africa. It lies approximately between 22°08' and 23°24' latitudes and 28°54' and 31°05' longitudes (Odhiambo and Magandini, 2008). The Vhembe District consists of four local municipalities: Collins Chabane municipality (22.5108°S, 30.8039°E), Makhado municipality (23.0462°S, 29.9047°E), Musina municipality (22.3953°S, 29.6963°E) and Thulamela municipality (22.8922°S, 30.6200°E). The Vhembe District shares borders with the Capricorn Mopani District Municipalities, Zimbabwe and Botswana in the North West and Mozambique in the south-east through the Kruger National Park (Kom et al., 2020). The District covers 21 407 square km of which 249 757 hectares are considered arable land. The Vhembe District is characterized by a subtropical climate. Its temperatures range from a minimum of 10ºC during winter to a maximum of 40ºC in summer with an annual rainfall of approximately 500mm of which 87.1% falls between October and March months (Kom et al., 2020*)*. Soils in the district are variable tending to be sandy in the west, but with a higher loam and clay content toward the east. The soils are mainly developed on basalt, sandstone and biotite gneiss and are generally of low inherent soil fertility. The smallholder farms are located mostly in the former homeland areas. Farming under a smallholder system is characterized by a low production level and small farm sizes of approximately 1.5 hectares with production primarily for subsistence and slight marketable surplus (Odhiambo and Magandini, 2008).

The agricultural system in the Vhembe District is characterized by two types: large-scale commercial farming and smallholder farmers, with sweet potatoes, beans, vegetables, maize, tomatoes, and pumpkins as commonly grown vegetables (Kom *et al.,* 2020*)*. Due to budget constraints, this study only focused on Collins Chabane Municipality and Thulamela Municipality. Following the local elections held on August 3, 2016, the Collins Chabane Local Municipality (CCLM) was created under Section 12 of the Municipal Structures Act (No. 117 of 1998). In the Vhembe District, the municipality is now the fourth Local Municipality

(Category B). It shares boundaries with Musina in the north, Thulamela in the northeast, the Mopani District in the south, and Makhado in the west. It is located in the northern region of the province of Limpopo. The region comprising the municipal area, which has a total area of 5 467.216 km2, was formerly a part of the Thulamela and Makhado Local Municipality. (Nyahunda and Tirivangasi, 2022).Thulamela municipality is situated in the eastern subtropical region of the province (Luvhimbi et al., 2022). The municipality is predominantly rural with a few formal towns and large villages with a major concentration of smallholder farmers and economic activities centred on Thohoyandou town (Lidzhegu and Kabanda, 2022).

3.2.2 Data collection

Data were collected from 319 from a population size of 580 smallholder farmers through a probability sampling method involving a stratified and simple random sampling technique. A pre-tested questionnaire was used as a primary data collection tool for the study. The questionnaire was administered by well-trained enumerators using face-to-face interviews with the respondents. Questionnaire instruments were further translated into the smallholder farmers' local language. In the questionnaire-based survey, 191 women and 128 men participated. In addition, a total of 19 female smallholder farmers and male smallholder farmers participated in four focus group discussions (FGDs). The FGDs were randomly selected participants who did not participate in the questionnaire interview. The four FGDs were divided into two groups of female smallholder farmers and two groups of male smallholder farmers to access full participation from female smallholder farmers in the absence of male smallholder farmers.

However, before collecting data in the study area, a probability sampling method involving a stratified random technique was used to select farmers. Farmers in the Vhembe District were divided into 2 sub-group municipalities (176 from Collins Chabane and 404 from Thulamela municipalities, respectively). The sample size determination for the study was computed based on the formula:

$$n = \frac{N}{Ne^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where *n* is the desired sample size; *N* is the total target population; *e* is the degree of accuracy required, normally set at 0.05 (5% of acceptable sampling error) (Kothari, 2004; Asfaw *et al.*, 2017). Therefore, a simple random sampling technique from each sub-group will be used to select 319 smallholder farmers (121 from Collins Chabane municipality and 198 from Thulamela municipality). For this study, the smallholder farmers were asked to rank the level of transparency and accountability by extension service providers (strongly disagree [0], disagree [1], neutral [2], agree [3], strongly agree [4]); respondents were further asked if they had access to credit? (No [0], yes [1]); respondents were asked if they had access to the market (no [0], yes [1]); respondents were asked about the extension feedback (extension feedback takes too long [0], extension feedback does not take too long [1]).

3.3 Ethics statement

The study was performed per the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments and approved by the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of KwaZulu-Natal (protocol reference number: HSSREC 00003210/2021). Accordingly, the Department of Agriculture in the Vhembe District of Limpopo Province granted permission to conduct the study in Thulamela Municipality and Collins Chabane Municipality in 2022.

3.4 Methods of analysis

Data were gathered via survey questionnaires, which were coded by giving each response a numerical code. Statistical Package for Social Scientists (SPSS) version 26 and stataSE 17 software was used to collect and analyze the data, respectively. The study's data on smallholder farmers were mostly summarized using frequencies and percentages. Using SPSS, the Shapiro-Wilk test was used to determine whether the explanatory factors were normal before the variables were analysed. According to the test, the data were regarded as normal if the Shapiro-Wilk test's p-value was higher than 0.05. Through SPSS, the T-test was applied to analyse the descriptive statistics for continuous variables. SPSS produced the p-values throughout the entire investigation. A parametric test known as One-Way Analysis of Variance (ANOVA) was utilized to analyse the descriptive statistics for continuous variables. SPSS produced the p-values for a one-way ANOVA parametric test. The variables were examined and found to be

normal, the variance in the samples was approximately comparable, and the data were drawn randomly and independently from the population to validate the ANOVA parametric test. The three thresholds of significance for the coefficients in the study were 1%, 5%, and 10%. For the econometrics modelling, STATA was employed.

3.5 Estimating factors affecting smallholder performance: Multiple linear regression model

A multiple linear regression model was used to analyse the relationship between the independent and dependent variables. The multiple linear regression model was used to address the second objective of the study. This model has a single respondent measurement Y which is related to multiple predictors X for each observation. This model was used because it explains the relationship between one continuous dependent variable and more independent variables. According to Tranmer and Elliot (2008), the advantages of analysing data using this model are that it can determine the influence of one or more predictor variables on the criterion value and the ability to identify outliers.

3.5.1 The General Multiple linear regression Model:

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n + \mu_i$

Where;

Y_i = dependent variable

β_0 = intercept

X_i = independent variables

β_i = estimated parameters

μ_i = disturbance term

3.5.2 Model Specification

Net Annual income from farmers production (NAIFP) = β_0 + β_1(Age) + β_2 (Gender) + β_3(Marital status)+ β_4(Education level) + β_5(Household size)+β_6(Land size) + β_7(Credit access

)+ β_8(Market access) + β_9(Extension access)+ β_{10}(Farming experience) + β_{11}(Extension feedback)+ β_{12}(Transparency and accountability)+ μ_i

3.6 Definition of variables

Table 3.1: Description of variables used in the multiple linear regression model.

Dependent variable	Description	Unit of measurement
Annual income from farmers' production	Total income earned by the household head	Rand (R)

Independent variables	Description and unit of measurement	Expected sign
Age	Categorical, level of household head age in years	+
Gender	Binary, 1 if the head is male and 0 if female	+/-
Marital status	Categorical, marital status level of household head	+
Education level	The categorical, educational level of the household head	+
Household size	Categorical, level of family size in numbers	-
Land size	Categorical, level of land size in hectares	+
Credit access	Binary, 1 if access credit and 0 otherwise	+
Market access	Binary, 1 if access market and 0 otherwise	+
Access to public extension	Binary, 1 if has access to public extension service and 0 otherwise	+
Access to privatised extension	Binary, 1 if has access to privatised extension service and 0 otherwise	+
Farming experience	Categorical, level of farming experience of the head in years	+
Extension feedback	Binary, 1 Extension feedback length too long and 0 otherwise	_
Transparency and accountability	Categorical, level of transparency and accountability by extension service personnel	+

Note: + means the variable is expected to have a positive effect on the dependent variable; - means the variable is expected to have a negative effect on the dependent variable. Source: Research survey, 2022.

3.7 Results

3.7.1 Descriptive Statistics

Table 3.2 shows the socio-economic demographic information of smallholder farmers who participated in this study. The independent variables used in the study were checked for normality and were deemed normal.

Table 3.2: Socio-economic demographic profiles of smallholder farmers.

Household characteristics		**Study Area**		**Total (*n*=319)**	**Percentage (%)**
		Collins Chabane Municipality	**Thulamela Municipality**		
Gender	Male	64	64	128	40.1
	Female	134	57	191	59.9
Age	<25	8	4	12	3.8
	26-35	20	15	35	11
	36-45	36	18	54	16.9
	46-55	51	37	88	27.6
	56-65	40	12	52	16.3
	66>	43	35	78	24.5
Marital status	Single	60	30	90	28.2
	Married	88	61	149	46.7
	Divorced	8	7	15	4.7
	Widowed	42	23	65	20.4
Educational level	Never attended	21	14	35	11
	Primary school	40	36	76	23.8
	Secondary school	100	46	146	45.8
	Tertiary	37	25	62	19.4
Household size	1-5	115	65	180	56.5
	6-10	81	52	133	41.8
	11-15	2	4	6	1.7

Source: Research survey, 2022.

The results in Table 3.2 showed that the sample of 319 smallholder farmers in the study area was dominated by female smallholder farmers 59.9%, while 40.1% of male smallholder

farmers participated in the study. Most smallholder farmers lay between the ages of 45 and 55 at 27.6%. About 24.5% of smallholder farmers were 66 years old and older, and some were less than 25 years of age (3.8 %,). About 46.7% of the smallholder farmers were married, 28.2% of the smallholder farmers were single, at least 20.4% were widowed, and about 4.7% of smallholder farmers were divorced in the study area. About 45.8% of the smallholder farmers attended secondary school, while 23.8% attended primary school. At least 19.4% attended tertiary, and about 11% of the smallholder farmers never attended school. Table 3.2 shows that about 56.5% of the smallholder farmers had a household size between 1 and 5 members, while 41.8% of the smallholder farmers had several family members ranging between 6 and 10, and about 1.7% of smallholder farmers had a household size ranging between 11 and 15.

3.7.2 Distribution of farm size in the study area

Figure 3.1 shows that 46 % of smallholder farmers had acquired a land size equivalent to 1 hectare, 32% of the smallholder farmers acquired a land size between 1 and 5 hectares, while 18% of the smallholder farmers had acquired a land size less than 1 hectare and about 4% of the smallholder had acquired a land size more than 5 hectares.

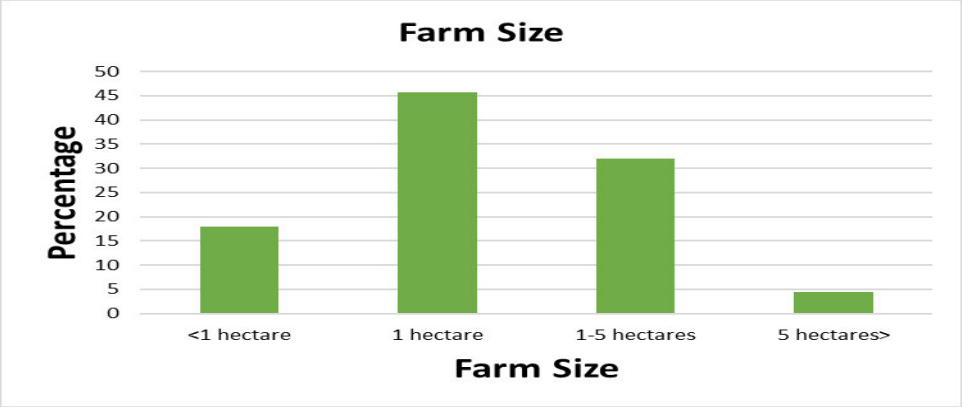

Figure 3.1 Smallholder farmers' farm size. Source: Research survey, 2022.

3.7.3 Smallholder farming experience

Figure 3.2 shows that 31 % of smallholder farmers had a farming experience between 11 and 20 years, while 27% of the smallholder farmers had a farming experience of less than 10 years. About 22% of the smallholder farmers had a farming experience of more than 31 years and about 21% of the smallholder had a farming experience between 21 and 30 years.

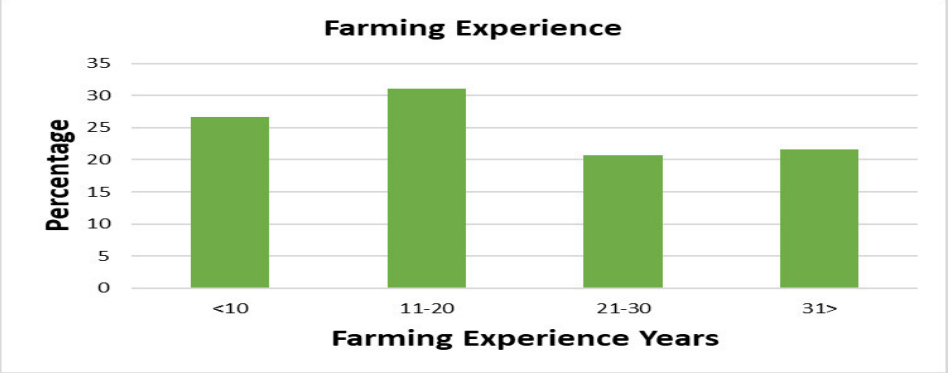

Figure 3.2: Smallholder's farming experience. Source: Research survey, 2022.

3.7.4 Lack of accountability and transparency by extension service providers

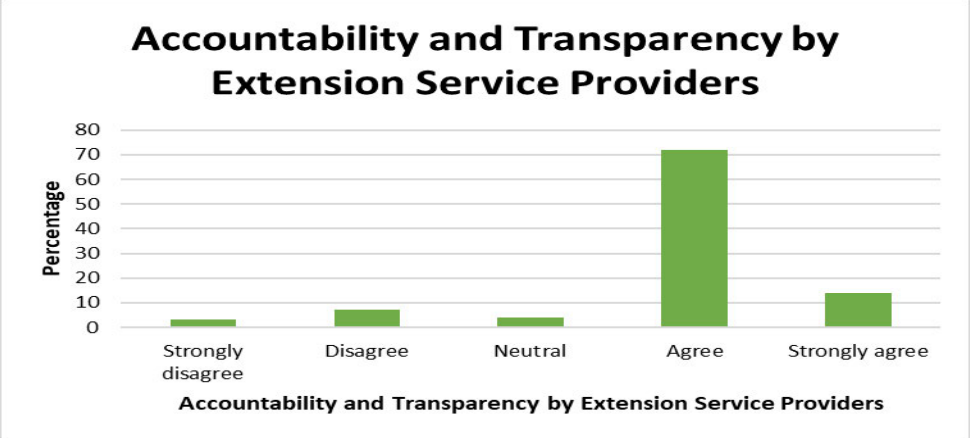

Figure 3.3:Lack of accountability and transparency by extension service providers Source: Research survey, 2022.

Figure 3.3 shows that 72% of the smallholder farmers agreed that they lacked accountability and transparency, while 14% of the smallholder farmers strongly agreed to extension service providers lacked accountability and transparency. About 7% of the smallholder farmers disagreed with extension service providers lacking accountability and transparency, 4% of the

smallholder farmers were neutral regarding extension service providers lacking accountability and transparency and smallholder farmers at 3% strongly disagreed with extension service providers lacking accountability and transparency in the study area.

3.7.4 Distribution of smallholder farmers' access to credit

Figure 3.4 shows that at least 27% of the smallholder farmers in the study area had access to credit, while 73% of the smallholder farmers had no access to credit in the study area.

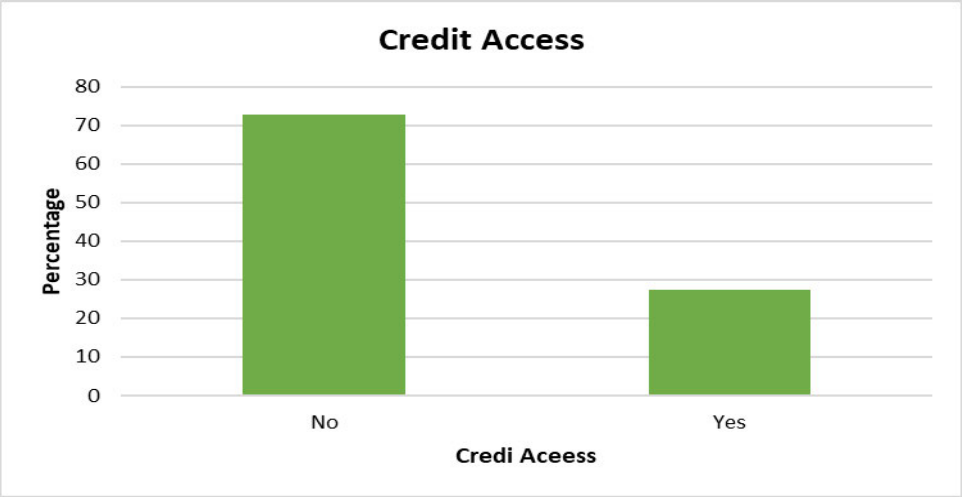

Figure 3.4:Smallholder farmers' accessibility to credit. Source: Research survey, 2022.

3.7.5 Smallholder farmers' accessibility to the market

Figure 3.5 shows that at least 34% of the smallholder farmers in the study area had access to the market, while 66% of the smallholder farmers had no access to the market in the study area.

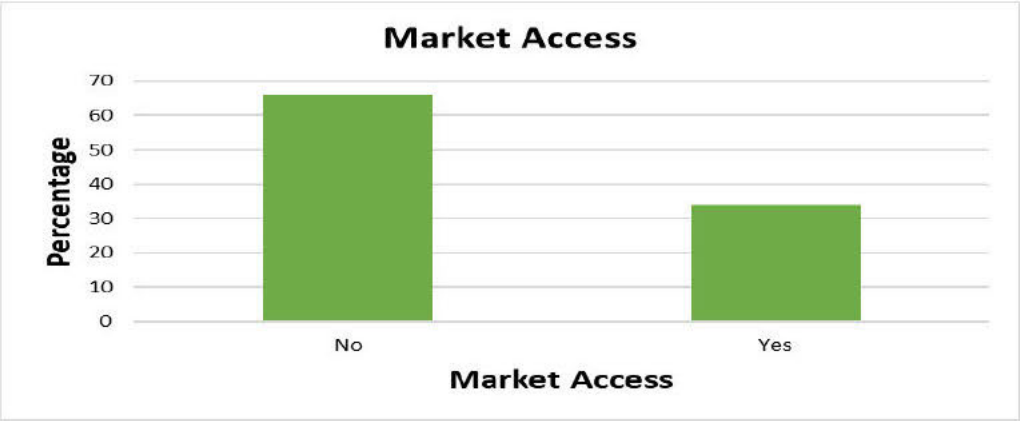

Figure 3.5:Smallholder farmers' accessibility to the market. Source: Research survey, 2022.

3.7.6 Smallholder farmers' accessibility to the extension service providers.

Figure 3.6 shows that at least 22% of the smallholder farmers in the study area had access to public extension service providers, and 78% of the smallholder farmers had no access to public extension services in the study area. Figure 3.7 also shows that 11% of the smallholder farmers did not have access to privatised extension service providers and 89% had access to privatised extension providers.

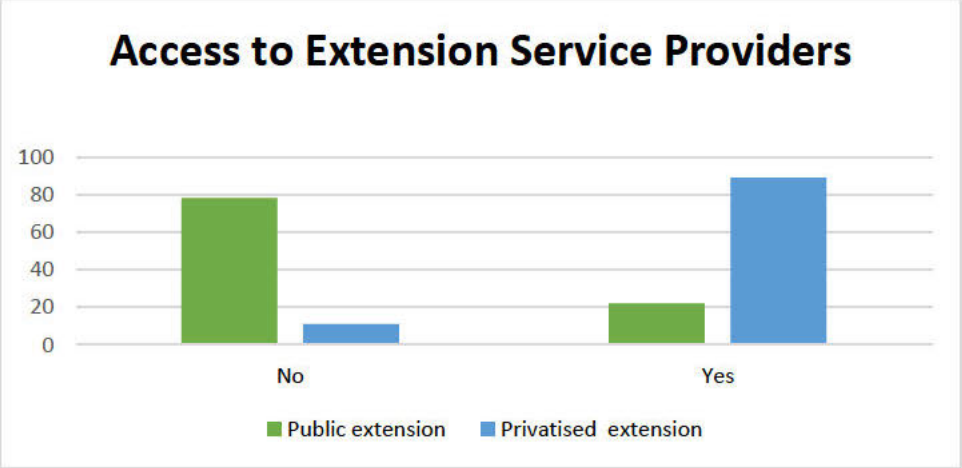

Figure 3.6:Smallholder farmers' accessibility to the extension services providers. Source: Research survey, 2022.

3.7.7 Feedback duration from extension officer.

Figure 3.7 shows that about 34% of the smallholder farmers in the study area agreed that extension officers do not take too long to bring feedback, while 66% of the smallholder farmers disagreed, stating that an extension officer takes too long to bring back feedback.

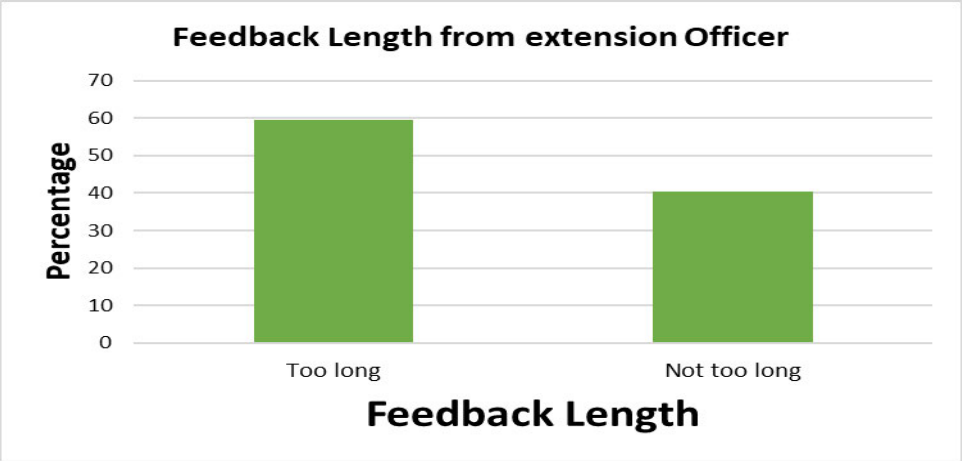

Figure 3.7:Feedback duration from extension officer. Source: Research survey, 2022.

Table 3.3 presents the T-test results of the continuous variables. A statistically significant relationship exists between annual income from farmers' production and access to extension services ($p<0.01$). A total of 69 smallholder farmers who had no access to the extension service providers had an average of R11588.13 annual income from their production. A total of 250 smallholder farmers who had access to the extension service providers had an average of R19417.04 annual income from their production.

Table 3.3:T-test results for Determinants of smallholder farmers' performance in the study area.

Variable (Mean)	Measure	Annual income from farmers' production	*n*	*p*-value
Access to public extension services	No	11588.13	69	***
	Yes	19417.04	250	
Access to privatised extension services	No	16906.81	34	**
	Yes	24570.59	285	
Gender	Male	13749.13	128	***
	Female	20387.18	191	
Extension feedback length	Too long	12610.02	190	***
	Not too long	21195.52	129	
Market access	No	14216.49	211	***
	Yes	19518.77	108	
Credit access	No	17498.93	232	ns
	Yes	17807.91	87	

Note: ******* mean the coefficient is statistically significant at 1% level. Ns= not statistically significant. Source: Research survey, 2022.

A statistically significant relationship in Table 3.3 was found in annual income from farmers' production and gender ($p<0.01$). A total of 128 male smallholder farmers had an average annual income from their production of about R13749.13, while 191 female smallholder farmers had an average annual income from their production of about R20387.18.

A statistically significant relationship in Table 3.3 was found between annual income from farmers' production and extension feedback length ($p<0.01$). A total of 190 smallholder farmers who received delayed feedback from extension officers had an average of R12610.02 annual income from their production. A total of 129 smallholder farmers who receive feedback on

time from extension officers had an average of R21195.52 annual income from their production.

A statistically significant relationship in Table 3.3 was found between annual income from farmers' production and extension market access ($p<0.01$). A total of 211 smallholder farmers who had no access to the market had an average of R14216.49 annual income from their production. A total of 108 smallholder farmers who had access to the market had an average of R19518.77 annual income from their production.

Table 3.4 presents the parametric One-way ANOVA results of continuous variables. The household size of smallholder farmers was statistically significantly different across the annual income from farmers' production ($p<0.01$). The ANOVA indicated that about 180 smallholder farmers with a household size between 1 and 5 have an average annual income of R20745.60, while 133 smallholder farmers with a household size between 6 and 10 have an average annual income of R29650.00, and about 6 smallholder farmers with a household size between 11 and 15 have an average income of R15678.57.

The results in Table 3.4 show that accountability and transparency by extension officers were statistically significantly different across the annual income from farmers' production ($p<0.01$). The ANOVA indicated that 229 of the smallholder farmers in the study agreed that smallholder farmers lacked accountability and transparency at an average annual income of R17506.18, while 44 of the smallholder farmers strongly agreed that extension service providers lacking accountability and transparency with an average annual income of R13777.84. The results in table 3.4 show that about 23 smallholder farmers disagreed with extension service providers lacking accountability and transparency with an annual average income of R26946.09, about 13 of the smallholder farmers were neutral regarding extension service providers lacking accountability and transparency had an annual average income of R17207.69 and the ANOVA results showed that 10 smallholder farmers strongly disagreed to extension service providers lacking accountability and transparency in the study area, had an average annual income of R19524.00.

Table 3.4:Parametric One-way ANOVA results between smallholder farmers' performance and socioeconomic parameters.

Variable (Mean)	Measure	Annual income from farmers' production	*n*	*p*-value
Age	<25	12175.00	12	ns
	26-35	15256.74	35	
	36-45	16571.76	54	
	46-55	21631.75	88	
	56-65	15978.58	52	
	66>	17235.90	78	
Marital status	Single	19489.51	90	
	Married	16543.91	149	
	Divorced	15650.67	15	
	Widowed	18461.26	65	
Educational level	Never attended	18475.03		
	Primary school	15880.62	35	
	Secondary school	19031.26	76	
	Tertiary	16479.42	146	
Household size	1-5	20745.60	180	***
	6-10	29650.00	133	
	11-15	15678.57	6	
Farm size	<1 hectare	17778.58	57	ns
	1 hectare	15962.55	146	
	1-5 hectare	20439.51	102	
	5>	16078.57	14	
Accountability and transparency	Strongly disagree	19524.00	10	***
	Disagree	26946.09	23	
	Neutral	17207.69	13	
	Agree	17506.18	229	
	Strongly agree	13777.84	44	
Farming experience	<10	20239.59	85	
	11-20	15089.53	99	
	21-30	14876.71	66	
	31>	21126.81	69	

Note: *** mean the coefficient is statistically significant at 1% level. ns= not statistically significant. Source: Research survey, 2022.

Table 3.5 displays the results of the variables' multicollinearity test, along with the variance inflation factor (VIF) for each variable. The variables showed a high level of tolerance, which suggested that there was no significant multicollinearity among the variables employed in the analysis. Both the Nagelkerke R square and the Cox and Snell square lacked statistical significance. This demonstrated that the data for this investigation suited the model effectively.

Table 3.5:Multicollinearity test for explanatory variables.

Variables	Collinearity statistics	
	Tolerance	**Variance Inflation Factor (VIF)**
Age	0.377	2.650
Gender	0.880	1.137
Marital status	0.700	1.429
Education level	0.696	1.437
Household size	0.977	1.024
Land size	0.945	1.058
Credit access	0.479	2.089
Market access	0.470	2.129
Public extension access	0.836	1.197
Privatised extension access	0.809	1.100
Farming experience	0.475	2.107
Extension feedback	0.679	1.473
Transparency and accountability	0.929	1.077

Source: Research survey, 2022.

A multiple linear regression model was used to estimate parameters responsible for smallholder farmers' performance among the smallholder farmers in the study areas (Table 3.5). The results indicate that all estimated coefficients are statistically significant P>F statistic is statistically significant ($p < 0.01$). The coefficients of the multiple linear regression model do not represent the magnitude of the effects of the explanatory variables. Instead, the marginal effects are

discussed. The marginal effects (ME) measure how a unit change of the average value of the independent variables influence the smallholder farmers' performance.

Table 3.6:Parameter estimates of the multiple linear regression on smallholder farmers' performance.

Independent variables	Coefficients	Robust Std. Error	p>z	Marginal Effects
Age	798.5133	1415.572	0.573	1415.572
Gender	5114.013	2718.233	0.061	2718.233*
Marital status	-616.379	1414.943	0.663	-1414.943
Education level	488.629	1672.531	0.770	1672.531
Household size	379.4328	546.6539	0.488	546.6539
Land size	895.5042	1630.685	0.583	1630.685
Credit access	-9052.274	4055.356	0.026	-4055.356**
Market access	-4014.01	3853.336	0.298	3853.336
Access to public extension	-7561.935	3320.066	0.023	-3320.066*
Access to privatised extension	24570.588	4185.132	0.033	7663.778**
Farming experience	-908.9099	1656.341	0.584	-1656.341
Extension feedback	-12641.12	3090.467	0.000	-3090.467***
Transparency and accountability	-3223.261	1518.573	0.035	-1518.573**
Constant	17426.89	8839.241	0.050	
Number of observations=319, R^2 = 0.106, P>F=0.000.				

Note: ***, ** and * mean the coefficient is statistically significant at 1%, 5% and 10% levels, respectively. Research survey, 2022.

3.8 Discussion

The study hypothesised that the performance of smallholder farmers is influenced by the accessibility of agricultural extension service providers and their services. In agreement with the results in Table 3.3, the results showed a statistically significant and negative relationship between access to public extension and net annual income from smallholder farmers in the

Vhembe District. Although the accessibility of public extension officers is crucial in the successful dissemination of agricultural information and overall efficiency of farm production (Kassem et al., 2021), contrary to expectations, the multiple linear regression model in Table 3.6 also showed that access to public extension is statistically significant and negatively influenced smallholder farmers net annual income performance. The marginal effects showed that a one-unit increase in access to the public extension would decrease net annual income from smallholder farmers' production by R3320.066. A plausible explanation could be that due to the bureaucratic financial challenges, the government is opposite, the public extension sector cannot afford to provide agricultural extension services to its end users (smallholder farmers) to their best potential. These results were consistent with those of Munishi et al. (2017), who asserted that the access to extension services had significantly lowered the performance of smallholder farmers due to the inability of the farmers to understand well various skills provided by extension officers, low implementation of these skills at the farm level and lack of qualified extension officers.

In agreement with the results in Table 3.3, the results showed a statistically significant relationship between access to privatised extension and net annual income from smallholder farmers. Similarly, the results in Table 3.6 also showed that access to privatised extension was statistically significant and, as expected, positively influenced net annual income from smallholder farmers. The marginal effects showed that when a one-unit increase in access to the privatised extension resulted in an increase in net annual income from smallholder farmers' production by R7663.778. The probable reason could be that smallholder farmers have access to various private extension service providers that provide respondents with highly private skilled extension officers, advanced information regarding the latest technology, inputs and markets where they can sell their products with the end goal of maximising profit.

The results in Table 3.3 showed a statistically significant and negative relationship between transparency and accountability and net annual income from smallholder farmers. Similarly, the results in Table 3.6 also show that transparency and accountability are statistically significant and, as expected, have a negative influence on net annual income from smallholder farmers. The marginal effects showed that a one-unit increase in transparency and accountability will increase net annual income from smallholder farmers' production by R1518.573. The rationale behind this result is that there could be a farmer-to-extension officer's

lack of accountability. Extension officers lack unity with smallholder farmers and do not share advanced farming information i.e., farmers do not spread information about where to sell their produce. This could affect smallholder farmers, maximizing their profit and decreasing the progress of rural development. Furthermore, without accountability from extension personnel, repeatable farming mistakes are likely to occur while reducing the chances of smallholder farmers to maximise their profit.

The results in Table 3.6, the results show that there is a statistically significant and negative relationship between credit access and net annual income from smallholder farmers. The marginal effects showed that a one-unit increase in credit access will decrease net annual income from smallholder farmers' production by R4055.356. A plausible explanation could be that smallholder farmers in the study area do not have access to various agricultural extension providers that could help respondents expand their farming area. During the focus group discussion, respondents stated that: *lack of credit has reduced farmers from acquiring more inputs, the ability to pay a farmworker and the ability to purchase implants for the farm, thus resulting in lowing their annual profits/income.* However, a study by Ahmed and Anang (2019) in Ghana asserted that access to credit had a statistically significant and positive association with smallholder farmers' income performance. The likely cause is the growing awareness of the critical role that agricultural financing plays in helping resource-poor farmers in developing countries like Ghana, Malawi, and South Africa increase their productivity and farm revenue. Agricultural finance facilitates the timely purchasing and best use of agricultural inputs to provide the best yield and hence increase farm profitability (Anang et al., 2020).

The results in Table 3.6, the results showed that there was a statistically significant and negative relationship between extension feedback and net annual income from smallholder farmers. The marginal effects showed that a one-unit increase in extension feedback would increase net annual income from smallholder farmers' production by R3090.467. A plausible explanation could be a delay regarding the turn-around time of the feedback information to smallholder farmers by extension officers in the study area. For instance, giving feedback regarding how to prevent pets and diseases while the damage is already done, thus negatively affecting the farmers' income.

The results in Table 3.3, the results showed that there was a statistically significant and positive relationship between gender and net annual income from smallholder farmers. Similarly, the

results in Table 3.6 also showed that gender was statistically significant and, as expected, positively influenced net annual income from smallholder farmers. The marginal effects showed that when a one-unit increase in gender will result in an increase in net annual income from smallholder farmers' production by R2718.233. A plausible explanation could be that female smallholder farmer generates their income through farm gate marketing, thus reducing travel costs, and they can commence their domestic chores. In their study of maize farmers, Ahmed and Anang (2019) found a statistically significant negative correlation between gender and farmers' income performance. Because males farming household heads often have more ownership and control over production resources and assets in most rural communities in Ghana's Tolon District and make more money from farming than their female counterparts. In addition to farming, women often have various responsibilities in the home, which limits the amount of time they can devote to it and lowers their agricultural revenue. Among the many duties women play include caring for children, running the family daily, and petty trading.

3.9 Conclusion and policy implications

The study aimed to evaluate factors affecting smallholder farmers' performance amongst smallholder farmers of Thulamela and Collins Chabane municipalities of Vhembe District, in Limpopo Province, South Africa. The multiple linear regression model revealed that lack of credit access, lack of access to public extension, poor extension feedback and transparency and lack of accountability negatively influenced the performance of smallholder farmers in the study area. Gender and access to privatised extension positively influenced the performance of smallholder farmers in the study area. Based on the study's findings, the lack of credit access lowered the respondents' performance. By implication, the study recommends that public and private stakeholders should ease credit access for smallholder farmers by creating accessible micro-lending depots for smallholder farmers, which will allow farmers to borrow money at low-interest rates and with reasonable collaterals. Farmers' cooperatives may also assist in bargain lending, where farmers may lend and purchase farm inputs for the best farm performance. Based on the study's findings, poor extension feedback lowered the respondents' performance.

The study concluded that the agricultural sector cannot stand alone to sustain livelihoods, reduce poverty and achieve food security for the irrigation farmworkers in the study area. The

conclusion is based on the study's hypothesis, the results showed that access to public extension as the source of agricultural extension service delivery system lowered the smallholder farmers' performance in the study area, while access to private extension as the source of agricultural extension service delivery system increased the smallholder farmers' performance in the study area. Based on the findings, the study recommends that public and private stakeholders should collaborate in addressing smallholder farmers' challenges. By implication, the study recommends that public and private stakeholders should encourage the establishment of framers' committees. Based on the study's findings, transparency and accountability lowered the respondents' performance. The study also recommends that public and private stakeholders should form study groups, workshops, farmer to farmer learning.

Smallholder farmers' performance is a broad subject whose accomplishment can be measured or carried out using various analytical tools such as multiple linear models, logit regression and ordinary least squares (OLS). This study only used the multiple linear models to analyse factors that influence smallholder farmers' performance in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. Therefore, the study's findings should not be generalized to all smallholder farmers' performance, as circumstances may be different. The study should be supplemented with studies that use other tools for smallholder farmers' performance so that a more comprehensive conclusion can be drawn. It is vital to note that ongoing research on the issue of smallholder farmers' performance with current extension service providers in rural area is needed. To fully understand the complex dynamics of this issue and to acquire more information regarding smallholder farmers' performance with current extension service providers in a rural area, this would include:

- Policymakers should design policies that are sensitive to the smallholder farming households' level characteristics in promoting income from the production output for rural households to sustainable livelihoods.
- Impact of training governmental extension officers towards improving smallholder farmers' income performance.
- A feasibility study in farmers' production to identify smallholder farmers' needs.
- Identification of all role players concerning smallholder farmers' performance.

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CHAPTER 4 FACTORS INFLUENCING THE PERCEPTION OF IMPLEMENTING A PLURALISTIC EXTENSION SYSTEM IN VHEMBE DISTRICT, SOUTH AFRICA

ABSTRACT

Agricultural extension plays a significant role in the development of agricultural production, particularly in agrarian economies. Several studies have emphasized how agricultural extension enhances agricultural production, assures food security, raises farm incomes, reduces poverty, and ascends development for smallholder farmers in rural areas. However, the empirical literature is scarce to guide agricultural extension and rural development policymakers regarding factors influencing the perception of implementing a pluralistic extension system among smallholder farmers. This study provides evidence that was carried out to analyse factors influencing the perception of implementing a pluralistic extension system among smallholder farmers in Thulamela and Collins Chabane Municipality, Vhembe District of Limpopo Province. Data were collected from 319 through a probability sampling method involving a stratified and simple random sampling technique. The data was analysed using the binary probit model. Among the variables considered in the binary probit model, age ($p<0.05$), the difference in production output ($p<0.1$), level of extension effectiveness ($p<0.1$), pluralistic extension knowledge ($p<0.01$), technology adoption ($p<0.1$) and distance to extension personnel ($p<0.05$) were found to significantly influence smallholder farmers performance. This study recommends that the government needs to implement refresher courses for public extension officers and workshops in their fields.

Keywords: Extension knowledge; public sector; reform extension; socio-economic effects

4.1 Introduction

It is commonly recognised that agricultural extension plays a significant role in the development of agriculture, particularly in agrarian economies. Several studies have emphasized how agricultural extension enhances agricultural production, assures food security, raises farm incomes, reduces poverty, and speeds up development (Ragasa and Mazunda 2018; Babu and Joshi 2019; Namyenya, 2022). However, agricultural extension agencies still struggle to set up a well-managed and efficient system in many developing nations (Namyenya, 2022). According to the World Bank (2010), this makes it clear that public extension cannot assist resource-poor farmers because there are insufficient connections between research and extension, limited financial support, and inadequate human resource and facility support. The system's designer also emphasized the following attributes: a single line of command with multiple levels of management between the field and supervisor; internal technical expertise, whereby subject matter experts are to provide training; exclusive dedication to information dissemination; and, among other things, a seasonal workshop with research personnel (Anderson and Feder, 2003).

Challenges experienced by the public sector are as follows; extremely low number of extension agents to-farmer ratios, a lack of critical technical and communication skills for effective operation, a lack of a clear work plan, a shortage of qualified and trained extension staff using outdated information, inadequate transportation and logistics, weak, deteriorating infrastructure, issues with extension organization and management, unclear extension mandates, and a lack of job descriptions for staff. In addition, the public sector offers poor remuneration to the extension personnel and a high rate of absence among staff (Naswem et al., 2008; Baig and Aldosari 2013; Sennuga et al., 2020). In response to the worrying performance in the agricultural sector, governments worldwide have implemented several reforms to enhance the delivery of agricultural extension services in developing nations like Uganda, South Africa, and Nigeria (Namyenya, 2022).

4.1.1 The evolution of agricultural extension in South Africa

Africa is the only continent in the world where agricultural output is mostly unchanged while population growth is high (FAO 2015; Sennuga et al., 2020). As a result, the continent's people

face food insecurity and malnutrition (FAO, 2015; Sennuga et al., 2020). Several factors have hindered agricultural production, including inadequate science and technology development, poor research distribution, inefficient use of soil resources, low commodity prices, unstable markets for agricultural products, and storage issues (Sennuga et al., 2020). To bring about change in agriculture, it is essential to provide farmers with the relevant information at the correct time (Maoba, 2016). The agriculture industry is essential to rural development and makes a considerable contribution to any program to fight poverty. Because of this, there is a huge need for efficient advising and extension services. In South Africa, agricultural extension has undergone a fundamental transformation from a dualistic service (different services for commercial and small-scale farmers) to a single amalgamated service that prioritizes the needs of the historically underserved small-scale and large-scale commercial farmers (Maoba, 2016).

The top-down extension approach, directly related to the diffusion of innovation theory, is a system whereby agricultural information from universities or the ministry of agriculture is distributed to farmers through extension agents. This extension structure is referred to as the Transfer of Technology (TOT) through extension personnel, who serve as farmers' passive recipients of technology from researchers. The top-down extension system assisted in promoting agricultural messages that were created and developed by research scientists, with little involvement from the end users (farmers), in developing nations like South Africa, Nigeria, and Malwa (Oladele, 2011). The top-down methodology disseminated technologies vertically. This paradigm involves a one-way information transmission where innovations are created at research stations and distributed to extension agents who then distribute them to farmers (Emeana et al., 2019).

The Ministry of Agriculture's information flow is entirely supply-driven, meaning that the technical knowledge distributed to the field is frequently inaccurate, outdated, and inappropriate for the circumstances at hand (Sennuga et al., 2020). Farmers, therefore, view the public extension staff's ability to provide accurate information as a serious flaw where a top-down strategy continues to limit the full potential of the extended service delivery system (Oladele, 2011). Due to the limited reach of public extension services, access to extension for smallholder farmers is a problem under the ministry-based extension model. A significant portion of the rural population frequently receives few communications from the public extension model. Due to the high expense of financing it in the 1980s and criticisms of its

insignificance, inefficiency, incompetence, and lack of equity, the public extension came under fire (Sennuga et al., 2020; Mapiye, 2021).

Several studies have highlighted the contribution of agricultural extension towards improving agricultural productivity, ensuring food security, increasing farm incomes, alleviating poverty and thus accelerating development (Ragasa and Mazunda 2018; Babu and Joshi 2019; Namyenya, 2022). However, there is little attention in research to guide agricultural extension and rural development policymakers concerning the factors influencing the perception of implementing a pluralistic extension system among smallholder farmers in the Vhembe District of Limpopo Province in South Africa. Hence, this study analysed factors influencing the perception of implementing a pluralistic extension system among smallholder farmers in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The hypothesis is that implementing a pluralistic extension system is influenced by general knowledge and perception of extension services that smallholder farmers have. To test our hypothesis, we used a T-test for continuous variables and a chi-square test for categorical variables to indicate the association between smallholder farmers' performance with different economic parameters. Furthermore, a binary probit regression model was used to analyse factors influencing the perception of implementing a pluralistic extension system among smallholder farmers.

4.2 Materials and methods

4.2.1 Description of the study area

The description of the study area is presented in Chapter 3 (3.2.1).

4.2.2 Data collection

Through a probability sampling approach incorporating a stratified and simple random sampling technique, data were gathered from 319 out of a population size of 580 smallholder farmers. The main tool for gathering data for the study was a translated questionnaire that had been pre-tested. Face-to-face interviews with the respondents were used by skilled enumerators to deliver the questionnaire. There were a total of 191 women and 128 males who took part in

the questionnaire-based survey. Four focus group talks included a total of 38 smallholder farmers. Participants in the FGDs were chosen at random from among those who declined to take part in the questionnaire session. To ensure complete participation from female smallholder farmers, the four FGDs were divided into two groups of female and two groups of male smallholder farmers.

However, before collecting data in the study area, a probability sampling method involving a stratified random technique was used to select farmers. Farmers in the Vhembe District were divided into 2 sub-group municipalities (176 from Collins Chabane and 404 from Thulamela municipalities respectively). The sample size determination for the study was computed based on the formula:

$$n = \frac{N}{Ne^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where n is the desired sample size; N is the total target population; e is the degree of accuracy required normally set at 0.05 (5% of acceptable sampling error) (Kothari, 2004; Asfaw et al., 2017). Therefore, from each sub-group, a simple random sampling technique will be used to select a total of 319 smallholder farmers (121 from Collins Chabane municipality and 198 from Thulamela municipality). For this study, the smallholder farmers were asked to rank the level of extension service effectiveness (Very effective [0], Effective [1], Ineffective [2], Very ineffective [3]); respondents were further asked if they had access to credit (No [0], yes [1]); respondents were asked if they had access to the market (no [0], yes [1]); respondents were asked they had learned about the pluralistic extension (No [0], Yes [1]). Respondents were asked to rank the level of the method used by extension personnel (No activity [0], Poor [1], Average [2], Good [3], Very good [4]).

4.3 Ethics statement

The ethics statement is presented in chapter 3 (3.3).

4.4 Methods of analysis

Data were gathered via survey questionnaires, which were coded by giving each response a numerical code. Statistical Package for Social Scientists (SPSS) version 26 and stataSE 17 software was used to collect and analyze the data. The study's data on smallholder farmers were

mostly summarized using frequencies and percentages. Using SPSS, the Shapiro-Wilk test were used to determine whether the explanatory factors were normal before the variables were analysed. According to the test, the data were regarded as normal if the Shapiro-Wilk test's p-value was higher than 0.05. The three thresholds of significance for the coefficients in the study were 1%, 5%, and 10%. For the econometrics modelling, STATA was employed.

4.5 Estimating factors influencing the perception of implementing a pluralistic extension system: Binary probit regression model

The binary probit model was employed to determine whether smallholder farmers are willing to implement a pluralistic extension system or not. A binary probit regression was the chosen econometric model for this purpose. The assumption under this model are: (1) We must have enough data of more than 30 observations, (2) the data is assumed to follow a standard normal, and the error follows the standard normality and lastly (3) the categorical predictors are assumed to have a linear effect on the response variable (Moore, 2013). The model perfectly fits the objective well, as it takes into account where the dependent variable is of two categorical outcomes, farmers who want to implement a pluralist extension system or not implement a pluralist extension system which is coded as 1 and 0, respectively.

The model could be econometrically stated as:

$$P_i = F(Z_i) = \frac{1}{1 + e^{-(\alpha + \sum \beta i X_i)}} \quad (1)$$

Were P_i is the probability that a respondent implements a pluralist extension system; X_i represents the ith explanatory variables; α and $\beta_i$are regression parameters to be estimated and e is the base of the natural logarithm.

For ease of interpretation of the coefficients, a probit model could be written in terms of the odds and log of odds. The odds ratio is the ratio of the probability that a respondent diversify livelihood income (P_i) to the probability that a respondent did not diversify livelihood income (1-P_i).

That is, $\left(\frac{P}{1-P}\right) = e^{Z_i}$ (2)

And taking the natural logarithm of equation (2) yields:

$$In\left(\frac{P}{1-P}\right) = e^{Z_i} = Z\,i = \alpha + \beta 1\,X_1 + \beta 2\,X_2 + \ldots\ldots + \beta m X_m \quad (3)$$

If the disturbance term Ui is considered, the probit model becomes:

$$Zi = \alpha + \sum_{i=1}^{m} \beta i\,X_i + Ui \quad (4)$$

Where X_i represents the i[th] predictor variables. The parameters of the model, α and β can be estimated using the maximum likelihood method (Moore, 2013)

Table 4.1:Description of the dependent variable used in the model

The binary probit regression model	
y = 0	Extension should not privatise
y = 1	Extension should be privatised

Source: Research survey, 2022.

Table 4.2:Description of variables used in the binary probit model.

Variables	Description and unit of measurement	Expected sign
Age	Categorical, level of household head age in years	-
Gender	Binary variable, 1 if the head is male and 0 if female	+/-
Marital status	Categorical, marital status level of household head	+
Education level	The categorical, educational level of the household head	+
Household size	Categorical, level of family size in numbers	-
Differences in production output	Binary variable, 1 if yes and 0 otherwise	-
Credit access	Binary variable, 1 if access credit and 0 otherwise	-
Market access	Binary variable, 1 if access market and 0 otherwise	-
Extension access	Binary variable, 1 access to extension service and 0 otherwise	-
Farming experience	Categorical, level of farming experience of the household head in years	+
Effectiveness of extension services	Binary variable, 1 if extension services are effective and 0 otherwise	-
Level of extension service effectiveness	Categorical, Level of extension service effectiveness	-
Pluralistic extension knowledge	Binary variable, 1 if the head has pluralistic extension knowledge and 0 otherwise	+
Technology adoption	Binary variable, 1 if household head adapts well to technology and 0 otherwise	+
Distance to extension personnel	Categorical, distance to extension personnel in km	-

Note: + means the variable is expected to have a positive effect on the dependent variable; - means the variable is expected to have a negative effect on the dependent variable. Source: Research survey, 2022.

4.6 Results

4.6.1 Descriptive Statistics

The description of the study area is presented in Chapter 3 (3.2.1).

4.6.2 Perceived effectiveness and level of effectiveness of extension services by smallholder farmers in Vhembe district.

Figure 4.1 shows that 28% of the smallholder farmers perceived agricultural extension services to be effective, while 72% of the smallholder farmers in the study area perceived agricultural extension services provided to be ineffective.

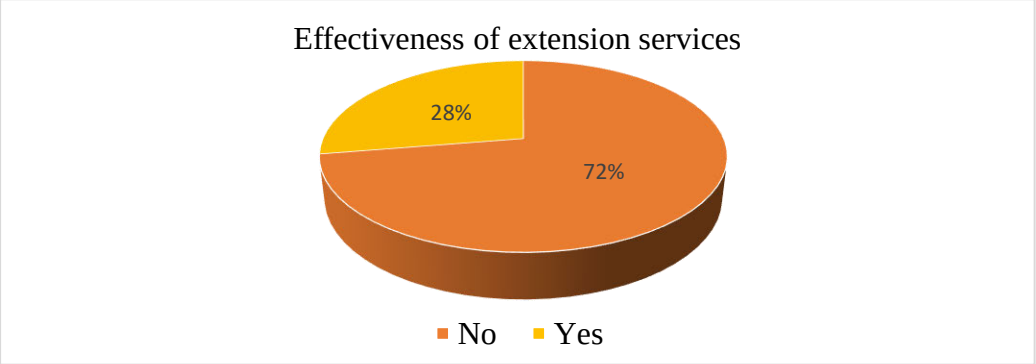

Figure 4.1: . Perceived effectiveness of extension services by smallholder farmers. Source: Research survey, 2022.

Figure 4.2 shows the perceived level of effectiveness of the extension services provided to smallholder farmers by extension personnel. A total of 9% of smallholder farmers perceived extension personnel to be very effective, 21% of the respondents perceived extension service providers to be effective, 40% of the respondents perceived extension service providers to be ineffective, 30% of the respondents perceived extension service providers to be very ineffective.

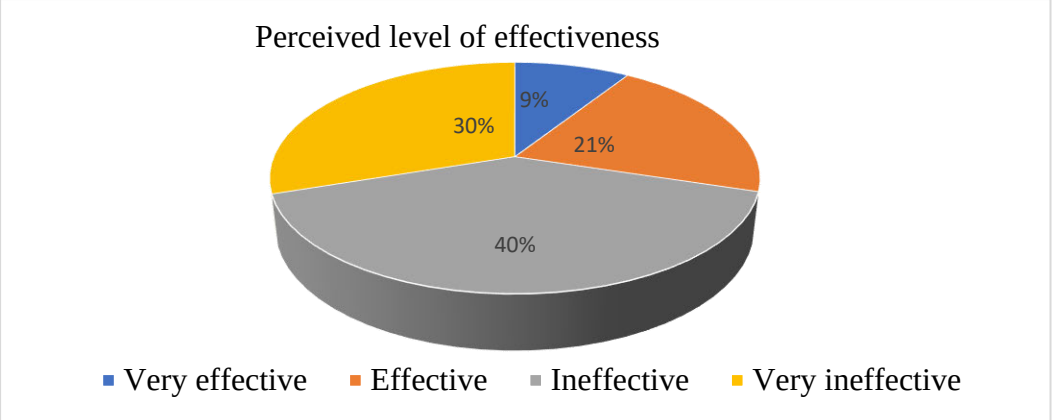

Figure 4.2:. Perceived level of effectiveness of extension services. Source: Research survey, 2022.

Smallholder farmers perceived the level of methods used by extension personnel and the knowledge of implementing a pluralistic extension system. Farmers must visit the fields to learn practical skills through demonstration and conversation in the regional language by extension agents. However, the results in Table 4.3 presented that 43.3% of smallholder farmers experienced no activity of farm visits by extension personnel, 35.7% perceived farm visits, and at least 6.6% perceived the level of the method used by extension personnel to be very good. The results in Table 4.3 presented that the majority of smallholder farmers perceived office calls to be poor at 57.4% by extension personnel to be poor, and at least 5% perceived the level of the method used by extension personnel to be very good. The results in Table 4.3 presented that 15% of smallholder farmers experienced no activity of demonstrations by extension personnel, 6.7% perceived demonstrations by extension personnel to be poor, and at least 6.6% perceived the level of the method used by extension personnel to be very good. The results in Table 4.3 presented that 36.1% of smallholder farmers in the study area experienced no activity regarding field days by extension personnel, 36.7% of field days methods used by extension personnel were perceived to be poor and at least 8.5% of perceived level of the method used by extension personnel to be good.

The results in Table 4.3 presented that 27.6% of smallholder farmers were not accessed training days by extension personnel, 55.5.7% of farmers' training days by extension personnel was perceived to be poor, and at least 7.8% of the respondents perceived the level of the method used by extension personnel to be good. The results in Table 4.3 presented that the majority of smallholder farmers experienced no activity, 47.6%, 37% perceived district affairs by

extension personnel as poor and at least 7.8% perceived the level of the method used by extension personnel to be good. The results in Table 4.3 presented that the majority of smallholder farmers experienced no activity of farmer field schools 47.3%, 37% of the smallholder farmers perceived farmer field schools by extension personnel to be poor and at least 8.2 % of perceived level of the method used by extension personnel to be good. The results in Table 4.3 presented that respondents perceived group meeting methods used by extension personnel to be poor 16.3%, group methods were perceived by an average of 42%, and at least 17.6% perceived the level of the method used by extension personnel to be very good.

Table 4.3: Smallholder farmers' perception of the level of the method used by extension personnel.

The method used by extension personnel	Perceived level of the method used by extension personnel				
	No activity	**Poor**	**Average**	**Good**	**Very good**
Farm visit	138(43.3)	114(35.7)	12(3.8)	34(10.7)	21(6.6)
Office calls	51(16.0)	183(57.4)	40(12.5)	29(9.1)	16(5.0)
Demonstrations	48(15.0)	206(64.6)	17(5.3)	27(8.5)	21(6.6)
Field days	115(36.1)	117(36.7)	45(14.1)	27(8.5)	15(4.7)
Farmers training days	88(27.6)	177(55.5)	17(5.3)	25(7.8)	12(3.8)
District affairs	152(47.6)	120(37.6)	10(3.1)	25(7.8)	12(3.8)
Farmer field schools	151(47.3)	118(37.0)	12(3.8)	26(8.2)	12(3.8)
Group meetings	26(8.2)	52(16.3)	134(42.0)	51(16.0)	56(17.6)

Note: Figures in parentheses are percentages—source: Research survey, 2022.

Figure 4.3 shows that 31% of the smallholder knew about the pluralistic extension, while 69% of the smallholder farmers in the study area did not know about pluralistic extension.

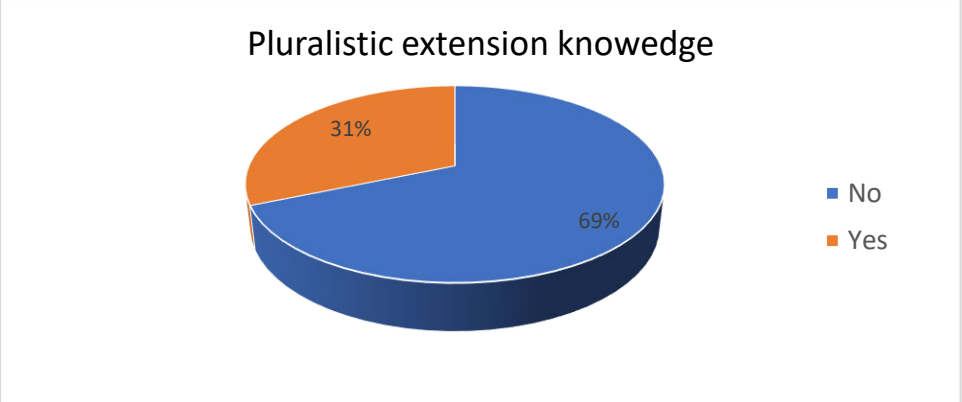

Figure 4.3: Pluralistic extension knowledge among smallholder farmers. Source: Research survey, 2022.

4.6.3 Smallholder farmers' perception of public extension services, level of public extension service effectiveness and pluralistic extension approach.

Smallholder farmers were asked about the effectiveness of their current extension service provider. Their findings indicated that 72% of the respondents asserted that the public extension service provider is ineffective (Figure 4.2). During the FGDs, some of the smallholder farmers in Thulamela and Collins Chabane Municipalities of Vhembe District mentioned that:

The government does not have enough money to satisfy the farmer's needs. A private entity or sector has to step in and help the state to assist us, farmers, in this municipality… (Female, Thulamela Municipality)

One issue I have observed is that of a farmer ratio with extension officers. Extension officers deal with too many farmers at a time, and sometimes, we go for months without being attended to by a governmental extension officer. The government needs to bring change by hiring more staff. The public sector needs to hire the youth, youth who are still motivated and who have the drive to disseminate old age farmers with information or demonstrations with tolerance … (Male, Thulamela Municipality)

Smallholder farmers from Collins Chabane also perceived the effectiveness of their extension source in their area. The following statements show:

Public extension officers do not work in our area. We are on our own. So far we are trying to create our own cooperate group to at least disseminate farming information amongst us… (Female, Collins Chabane Municipality)

In addition, a key informant from Vhembe District mentioned that:

The governmental extension offices in my area are damaged. From my observation, the extension service centre is going down. I would not advise anyone to dwell on agricultural activities to sustain their well-being… (Male, Collins Chabane Municipality)

Smallholder farmers were asked to rank the level of effectiveness of their current extension service provider. Their findings indicated that 40% were ineffective and 30% were very ineffective (figure 4.3). During the FGDs, some of the smallholder farmers in Thulamela and Collins Chabane Municipalities of Vhembe District mentioned that:

It is too difficult to get noticed by the government. We have no support from the public extension officers. We work under the sun day in and day out with the hopes of getting support from the government… (Female, Thulamela Municipality)

We are still struggling regardless of the existence of extension officers. We cannot point out their work. We have reported issues such as fencing and cows destroying our farms, and we cannot sell our maize. Furthermore, extension officers claim that our roads are bad hence they do not come to our area often… (Male, Collins Chabane Municipality)

A total of 69% of the smallholder farmers in the study area had no knowledge of pluralistic extension (Figure 4.4). Smallholder farmers and key informants said:

I have no knowledge of that because in my village we do things on our own. Extension officers are not known in my village, however, I do know that they exist… (Female, Collins Chabane Municipality)

We lack knowledge about almost everything. We do not even understand the extension officers' duties or roles… (Male, Collins Chabane Municipality)

In addition, key informants Vhembe District mentioned that:

The public sector has been letting my farming community down for years. I would not encourage anyone to join farming in my village. Farming is expensive with too little income return… (*Male, Collins Chabane Municipality)*

Table 4.4 presents the T-test results of continuous variables. A statically significant relationship exists between smallholder farmers willing to implement privatisation of extension and household size ($p<0.05$). The T-test indicated that smallholder farmers with a mean household size of 5 disagreed with the implementation of privatisation of extension, while smallholder farmers with a mean household size of 8 agreed to the implementation of privatisation of extension in the public sector.

Table 4.4:T-test results for smallholder farmers' privatisation of extension determinants.

Variable (Mean)	Measure	Privatisation of extension	*n*	*p*-value
Household size	No	5.12	34	**
	Yes	8.38	285	

Note: ***, ** and * mean the coefficient is statistically significant at 1%, 5% and 10% levels, respectively. Research survey, 2022.

Table 4.5 presents the chi-square test results of the categorical variables. A statically significant relationship exists between smallholder farmers willing to implement privatisation of extension and age ($p<0.05$). Table 4.5 shows that 33.3% of the smallholder farmers under the age of 25 or less were not willing to privatise public extension services and 66.7% were willing to implement the privatisation of public extension services.

In the category of smallholder farmers who were between the ages of 26 and 35, 5.9% were not willing to implement the privatisation of public extension services and 11.6% were willing to implement the privatisation of public extension services. In the category of smallholder farmers between the ages of 36 and 45, 8.8% of the smallholder farmers were not willing to privatise public extension services and 17.9% were willing to implement the privatisation of public extension services. In the category of smallholder farmers who were between the ages of 46 and 55, (41.2%) were not willing to implement the privatisation of public extension services and 26% were willing to implement the privatisation of public extension services. In

the category of smallholder farmers who were between the ages of 56 and 65, 17.6% were not willing to implement the privatisation of public extension services and 16.1% were willing to implement the privatisation of public extension services. In the category of smallholder farmers who were between the ages of 66 and more, 26.5% of the smallholder farmers were not willing to implement the privatisation of public extension services and 24.2% were willing to implement the privatisation of public extension services. A statically significant relationship exists between smallholder farmers willing to implement privatisation of extension and gender ($p<0.1$). The results indicated that 42.1% of male smallholder farmers were not willing to implement the privatisation of public extension services, while 40% were willing to implement the privatisation of public extension services. The results indicated that 58.8% of female smallholder farmers were willing to implement the privatisation of public extension services, while 60% were not willing to implement the privatisation of public extension services.

A statically significant relationship exists between the smallholder farmers willing to implement privatisation of extension and the technology adaption ($p<0.01$). The results indicated that of smallholder farmers who had a low technology adaption, 20.6% of the smallholder farmers were not willing to implement the privatisation of public extension services and 66% were willing to implement the privatisation of public extension services. Of smallholder farmers who had a low technology adaption, 35.3% of the smallholder farmers were not willing to implement the privatisation of public extension services and 25.6% were willing to implement the privatisation of public extension services. Regarding smallholder farmers who had a high technology adaption, 44.1% of the smallholder farmers were not willing to implement the privatisation of public extension services and 8.4% of the respondents were willing to implement the privatisation of public extension services.

Table 4.5:Association between the privatisation of extension and socioeconomic parameters.

Variable	Measure	Extension should not privatise n = 34 (%)	Extension should be privatised n = 285 (%)	X^2 sig. level
Age	<25	0 (0)	12 (4.2)	
	26-35	2 (5.9)	33 (11.6)	
	36-45	3 (8.8)	51 (17.9)	**
	46-55	14 (41 2)	74 (26.0)	
	56-65	6 (17.6)	46 (16.1)	
	66>	9 (26.5)	69 (24.2)	
Gender	Male	14 (41 2)	114(40.0)	*
	Female	20 (58.8)	171 (60)	
Marital status	Single	9 (26.5)	81(28.4)	
	Married	18 (52 9)	131 (46.0)	
	Divorced	3 (8.8)	12 (4.2)	ns
	Widowed	4 (11.8)	61 (21.4)	
Educational level	Never attended	3 (8.8)	32 (8.8)	
	Primary school	8 (23.5)	68 (23.9)	ns
	Secondary school	20 (58.8)	126 (44.2)	
	Tertiary	3 (8.8)	59 (20.7)	
Differences in production output	No	5 (14.7)	202 (70)	ns
	Yes	29 (85 3)	83 (29.1)	
Credit access	No	15 (44 1)	217 (55.9)	
	Yes	19 (55 9)	68 (23.9)	
Market access	No	14 (41 2)	197 (69.1)	
	Yes	20 (58.8)	88 (30.9)	
Extension access	No	1 (2.9)	68 (23.9)	
	Yes	33 (97 1)	217 (76.1)	
Farming experience	<10	11 (32.4)	74 (26.0)	ns
	11-20	8 (23.5)	91(31.9)	
	21-30	7 (20.6)	59 (20.7)	
	31>	8 (23.5)	61 (21.4)	
Effectiveness of extension services	No	7 (20.6)	224 (78.6)	ns
	Yes	27 (79.4)	61 (21.4)	
Level of extension effectiveness	Very effective	18 (52 9)	11 (3.9)	
	Effective	13 (38 2)	53 (18.6)	
	Ineffective	0	128 (44.9)	
	Very ineffective	3 (8.8)	93 (32.6)	
Pluralistic extension knowledge	Yes	18 (52.9)	201 (70.5)	
	No	16 (47 1)	84 (29.5)	
Technology adoption	low	7 (20.6)	188 (66.0)	
	Average	12 (35 3)	73 (25.6)	***
	High	15 (44 1)	24 (8.4)	
Distance to extension personnel	1-5	21 (61.8)	103 (36.1)	
	6-10	7 (20.6)	19 (6.7)	ns
	11-15	5 (14.7)	83 (29.1)	
	16>	1(2.9)	80 (28.1)	

Note: Figures in parentheses are percentages. ***, ** and * mean the coefficient is statistically significant at 1%, 5% and 10% levels, respectively. ns= not statistically significant. *n* = sample size. X^2= chi-square. Research survey, 2022.

Table 4.6 displays the results of the variables' multicollinearity test, along with the variance inflation factor (VIF) for each variable. The variables showed a high level of tolerance, which suggested that there was no significant multicollinearity among the variables employed in the analysis. Both the Nagelkerke R square and the Cox and Snell square lacked statistical significance. This demonstrated that the data for this investigation suited the model effectively.

Table 4.6:Multicollinearity Test for explanatory variables.

Variables	Collinearity statistics	
	Tolerance	**Variance Inflation Factor (VIF)**
Age	0.377	2.653
Gender	0.872	1.147
Marital status	0.697	1.434
Education level	0.686	1.458
Household size	0.979	1.021
Differences in production output	0.330	3.034
Credit access	0.369	2.712
Market access	0.411	2.432
Extension access	0.644	1.552
Farming experience	0.470	2.127
Effectiveness of extension services	0.340	2.938
Level of effectiveness	0.371	2.692
Pluralistic extension knowledge	0.793	1.261
Technology adoption	0.858	1.165
Distance to extension personnel	0.616	1.625

Source: Research survey, 2022.

The determinants influencing smallholder farmers' willingness to implement a pluralistic extension system in the study areas were estimated using a binary probit model (Table 4.7). The findings show that all calculated coefficients are statistically significant due to the statistical significance of the LR X2 statistic ($p<0.01$). The size of the impact of the explanatory variables is not depicted by the coefficients of the binary probit model. The marginal effects are instead discussed. The marginal effects measure how a change in the average value of the independent variables, expressed as a unit, affects the likelihood that a respondent in the study will implement a pluralistic extension system or not.

Table 4.7:Parameter estimates of the binary probit regression analysis on implementing a pluralistic extension system.

Independent variables	Coefficients	Robust Std. Error	Marginal Effects
Age	-0.327	0.164	-0.011**
Gender	-0.336	0.318	-0.011
Marital status	0.229	0.169	0.008
Education level	0.089	0.203	0.003
Household size	0.056	0.066	.002
Differences in production output	1.871	0.497	0.066***
Credit access	0.608	0.481	0.021
Market access	-0.019	0.496	-0.007
Extension access	-0.712	0.570	-0.025
Farming experience	-0.224	0.159	-0.007
Effectiveness of extension services	0.337	0.443	0.011
Level of extension effectiveness	0.646	0.231	0.022***
Pluralistic extension knowledge	0.611	0.332	0.021*
Technology adoption	0.647	0.202	0.022***
Distance to extension personnel	0.305	0.151	0.100**
Constant	1.839	1.284	
Number of observations=319, LR X^2 = 112.53 ***, Pseudo R^2= 0.51			

Note: ***, ** and * means the coefficient is statistically significant at 1%, 5% and 10% levels, respectively. Source: Research survey, 2022.

4.7 Discussion

The study hypothesis was that the implementation of a pluralistic extension system is influenced by the general knowledge and perception of government extension services that smallholder farmers have. In table 4.7, the binary probit regression showed that pluralistic extension knowledge was found to have a positive and statistically significant impact on the implementation of a pluralistic extension system in the public sector among smallholder farmers in the study area. The marginal effects showed that pluralistic extension knowledge of smallholder farmers had a 2.1% higher chance of agreeing to the implementation of a pluralistic extension system in the public sector. A plausible explanation could be that availability of knowledge and the perception of the public extension service smallholder farmers have could potentially increase extension to be demand-driven by smallholder farmers. Knowledge can be easily poured down from extension officer to farmer with ease. For instance, with the availability of skilled extension officers, farmers can be easily educated about the

implementation of pluralistic extension knowledge. A study by (Wambura et al., 2015) pointed out that the ability of rural farming households to improve food security and maintain their livelihoods has been a success factor in the information that is made available to farmers in rural areas. This could be information on how the extension should assist all types of farmers in dealing with escalating natural resource problems, including climate change, and comparative analysis of different extension strategies, organizational models, institutional innovations, and resource constraints (Wambura et al., 2015).

The results in Table 4.7 showed that there was a statistically significant and negative relationship between the respondent's age and implementing a pluralistic extension system. The marginal effect showed that a one-unit increase in the age of a smallholder farmer resulted in a 1.1% lower chance of agreeing to the implementation of a pluralistic extension system in the public sector. A plausible explanation could be that old-aged smallholder farmers are too rigid to learn about the advancement of farming. A study by Sennuga et al. (2020) pointed out that finding the ideal extension mix that may work for every farmer is made more difficult by the fact that older farmers find it incredibly difficult to take risks in experimenting with or adopting new farming production practices.

The binary probit regression, as shown in Table 4.7, indicated that the difference in production output was found to have a positive and statistically significant impact on the implementation of a pluralistic extension system to the public sector among smallholder farmers in the study area. The marginal effects showed that the difference in production output of smallholder farmers had a 6.6% higher chance of agreeing to the implementation of a pluralistic extension system in the public sector. A plausible explanation could be that smallholder farmers who agree and are motivated by the implementation of pluralistic extension are motivated by the production output.

The results in table 4.7, showed that there was a statistically significant and positive relationship between the level of extension effectiveness and the implementation of a pluralistic extension system in the public sector among smallholder farmers. The marginal effects showed that the difference in production output of smallholder farmers had a 2.2% higher chance if the public sector implements a pluralistic extension system. A plausible explanation could be that when the availability of varied extension personnel is disposed to smallholder farmers, who provide extension services, they will provide specific resources that a farmer needs, for

instance, advanced farming information. The implementation of a pluralistic extension system invites experts to specific fields i.e., crop and livestock production. The purpose of agricultural extension is to strengthen farmers' decision-making abilities. However, the ability of competent extension workers to impart knowledge to the farmer is a key factor in the effectiveness of extension services (Maoba, 2016). A strong or effective agricultural extension can make a substantial contribution to an increased or high yield, which can lead to sustainable agriculture, which will contribute to food security, the reduction of poverty, and the development of jobs (Maoba, 2016; Forbang et al., 2019).

The results in table 4.7 showed that there was a statistically significant and positive relationship between technology adoption and the implementation of a pluralistic extension system to the public sector among smallholder farmers. The marginal effects showed that technology adoption by smallholder farmers had a 2.2% higher chance if the public sector implements a pluralistic extension system. A plausible explanation could be that with the probability of implementing a pluralistic extension system, technology adoption can improve agronomic and livestock practices such as rearing livestock, weed control, soil fertility management and soil and water management among smallholder farmers in the study area. The results build on existing evidence by Wambura et al., (2015) and Tata (2018) that emerging technologies are starting to show potential and demand for extension services. A study by Tata (2018) demonstrated that much more farmer groups were successfully using the farm book technology. In a study conducted in Uganda among small- to medium-sized farm owners with limited resources, Martin and Abbott (2010) investigated the uptake and perceived effects of agriculturally oriented mobile phone use. With the help of their knowledgeable extension service staff, they discovered that 42% of farming rural households owned and used mobile phones for organizing inputs, receiving market information, and monitoring financial activities.

Table 4.7 showed that distance to extension personnel is statistically significant and positively influences the adoption and implementation of a pluralistic extension system in the public sector among smallholder farmers. The marginal effects showed that distance to extension personnel of smallholder farmers had a 10% higher chance if the public sector implements a pluralistic extension system. This finding may be explained by the lack of access to other (and better) information sources in rural areas or by the rural development policies' prioritization

and targeting of farmers in remote communities in their intervention efforts. (Ndoro et al., 2014) .

4.8 Conclusion and policy implications

The study aimed to analyse factors influencing the perception of implementing a pluralistic extension system among smallholder farmers in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The binary probit regression model revealed that age negatively influenced the probability of implementing a pluralistic extension system among smallholder farmers in the study area. While the difference in production output, level of extension effectiveness, pluralistic extension knowledge, technology adoption and distance to extension personnel positively influenced the probability of implementing a pluralistic extension system among smallholder farmers in the study area. Based on the study's findings, the age of the respondents lowered the probability of implementing a pluralistic extension system. By implication, the study recommends the government should improve farming with regards to the mechanization of farming activities to attract young graduates into the sector.

Regarding the study's hypothesis, the results showed that the implementation of a pluralistic extension system is influenced by the general knowledge and perception of extension services that smallholder farmers have. The study concludes that is imperative that agricultural training and extension programmes be intensive enough to promote the adoption not only of improved yield-raising technologies, such as improved seeds but also of fertility-restoring and conservation technologies. Based on these findings, this study recommends that the government needs to implement refresher courses for public extension officers and workshops in their fields.

Analysing factors that influence the perception of implementing a pluralistic extension system among smallholder farmers is a complex subject. This study only used the binary probit model to determine factors that influence the perception of implementing a pluralistic extension system among smallholder farmers in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The study should be supplemented with studies that use other tools for smallholder farmers' performance so that a more comprehensive conclusion can be drawn. It is vital to note that ongoing research on the issue of smallholder farmers' perception

of implementing a pluralistic extension system among smallholder farmers in rural area is needed. To fully understand the complex dynamics of this issue and to acquire more information regarding diverse conditions regarding the factors that influence the perception of implementing a pluralistic extension system among smallholder farmers in rural areas, this would include:

- A comparative investigation of public extension officers and private extension officers needs to be investigated through contract monitoring indicators.

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CHAPTER 5 THE WILLINGNESS OF SMALLHOLDER FARMERS TO PAY FOR EXTENSION SERVICES IN VHEMBE DISTRICT, SOUTH AFRICA

ABSTRACT

The majority of developing nations' economies are built on agriculture, and South Africa is no exception. Like in most African nations, the majority of people in South Africa live in rural areas and rely mostly on farming for their living. Successful farming is feasible in these places only when the necessary infrastructure and services are in place, such as access to markets, loans, and extension service providers. The study provides evidence that was carried out to examine the determinants of smallholder farmers' willingness to pay for extension services in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. Data were collected from 319 through a probability sampling method involving a stratified and simple random sampling technique. The data were analysed using a binary probit model. Among the variables considered in the binary probit model, marital status ($p<0.1$), land size ($p<0.01$), the difference in output ($p<0.05$), privatisation of extension ($p<0.01$), and distance to extension officer ($p<0.05$) were found to significantly influence smallholder farmers' willingness to pay for extension services. Based on these findings, this study recommends that public and private stakeholders encourage good quality production and access to the local market, contracts and privatising the government extension service to provide quality extension services.

Keywords: Paying extension outsources; smallholder farmers, privatisation; Thulamela Municipality; Collins Chabene Municipality

5.1 Introduction

The principles, rules, and criteria for extension advisory services in agriculture developed by the Ministry of Agriculture serve as the basis for extension service provision in South Africa (Maake and Antwi, 2022). In many developing nations in the past, extension services were predominately funded, overseen, and provided by state organizations, following the diffusion of innovation paradigm. The Training and Visit (T&V) strategy was the major method used by the diffusion of innovation model to impart knowledge to "contact farmers" in rural areas. These farmers were then expected to share the knowledge they had learned with the surrounding populations (Ateka et al., 2019; Mbeche et al., 2022). However, the literature has criticized public sector-led extension and its main model T&V for being centralized, dogmatic, and intolerant of a two-way flow of ideas and decision-making (Birner and Anderson 2007). Governments also faced a significant financial burden due to the delivery of T&V, which was made worse by decreased financing from multilateral funding agencies (Birner and Anderson 2007). Additionally, the methods employed were not very adaptable and gave resource-poor farmers advice that was less in line with their context, technical requirements, and financial situation (Musa et al., 2013; Mbeche et al., 2022).

Due to the majority of the touted technologies' low adoption by a sizable portion of farmers, their influence was minimal (Mbeche et al., 2022). Due to these difficulties, the republic has witnessed a departure of qualified extension professionals from governmental organizations to create private consulting firms (Loki et al., 2019). As a result, a pluralistic extension system that provides services to different farmers throughout South Africa now exists informally (Agbugba et al., 2020). Particularly in the poorest sections of the nation, such private or pluralistic kinds of extension and advisory services are not yet widely accepted or utilized (Agbugb et al., 2020). This is because of a variety of factors, including their restricted extension radius (coverage), popularity, and most significantly the fact that they operate on incentives. As a result, they only offer extension assistance to farmers who can afford to pay for services (Loki et al., 2019).

Farming is primarily subsistence-based in many emerging nations, particularly in Africa, where crop pests and diseases threaten farmers' livelihoods and socioeconomic standing (Ogunmodede et al., 2022). Farmers need prompt access to extension and advisory services to

handle these pest and disease issues for improved rural livelihoods and greater food security. Agricultural extension services have long given farmers access to a wide range of knowledge and innovations that can boost output, raise income, and allow a higher standard of living (Ogunmodede et al., 2022). However, public/conventional extension systems frequently fall short of meeting the diverse requirements of resource-poor farmers in many developing countries (Danielsen and Matsiko, 2016). For instance, farmers need more information and understanding about managing new invasive pests, but public extension systems might not be able to give them this support due to inefficiencies and resource limitations (Ogunmodede et al., 2022).

The optimal farmer-to-extension agent ratio, according to the Food and Agriculture Organization (FAO), is between 1:500 and 800. Unfortunately, many emerging nations have still had difficulty achieving this ratio. In Ghana, Nigeria, and Zambia, the expected extension agent-to-farmer ratios are 1:1500, 1:2500, and 1:1200-3000, respectively (Ajala et al., 2013; Ogunmodede et al., 2020). Due to the public extension systems' shortcomings, calls have been made for the private sector to assist in giving farmers with effective extension services (Ogunmodede et al., 2022). The marketing of extension services, according to Rivera and Sulaiman (2009), is only feasible if farmers are ready to pay for them, especially when the services have previously been offered gratis. As a result, there has been a rise in interest in recent years in learning more about farmers' readiness to pay (WTP) for extension services (Daniel and Teferi (2015); Ogunmodede et al., 2022).

Extension product or service's success or failure depends on developing an ideal pricing plan based on consumers' willingness to pay more for the value it provides (Kasilingam and Krishna, 2022). The definition of willingness to pay is "the highest amount of money a farmer is willing to pay for a good or service" (Homburg et al., 2005). The idea behind the promotion of privatizing extension services is that since the private sector is typically unrestricted by political and administrative regulations, it is more likely to distribute resources effectively (Loki et al., 2019). The theory is that by charging for extension services, private extension systems would be demand-driven and, as a result, would encourage extension service providers to be more attentive to farmers' needs, particularly those of poor and marginalized farmers (Mbeche et al., 2022).

Information on farmers' readiness to pay and the services they are willing to pay for becomes crucially important when looking for innovative delivery systems that can cut unnecessary government spending, improve extension efficiency, and meet farmers' demands (Afful and Lategan, 2014). Additionally, for a better understanding and application of commercial prospects for smallholders, South Africa's experiences with fee-based services need to be documented, studied, and communicated (Loki et al., 2019; Agbugba, 2020). However, such information is lacking or rather scarce in South Africa. Hence, this study analysed the determinants of smallholder farmers' willingness to pay for extension services in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province in South Africa. The hypothesis is that the willingness of smallholder farmers to pay for extension services is influenced by the implementation of privatising government extension services. To test our hypothesis, we used a T-test for continuous variables and a chi-square test for categorical variables to indicate the association between smallholder farmers' performance with different economic parameters. Furthermore, the binary probit regression model was used to analyse the determinants of smallholder farmers' willingness to pay for extension services.

5.2 Materials and methods

5.2.1 Description of the study area

The description of the study area is presented in Chapter 3 (3.2.1).

5.2.2 Data collection

Data were collected from 319 from a population size of 580 smallholder farmers through a probability sampling method involving a stratified and simple random sampling technique. A pre-tested questionnaire was used as a primary data collection tool for the study. The questionnaire was administered by well-trained enumerators using face-to-face interviews with the respondents. In a questionnaire-based survey, a total of 191 women and 128 men participated. A total of 19 female smallholder farmers and male smallholder farmers participated in four focus group discussions (FGDs). The FGDs were randomly selected participants who did not participate in the questionnaire interview. The four FGDs were divided into two groups of female smallholder farmers and two groups of male smallholder farmers to

access full participation from female smallholder farmers in the absence of male smallholder farmers.

However, before collecting data in the study area, a probability sampling method involving a stratified random technique will be used to select farmers. Farmers in the Vhembe District were divided into 2 sub-group municipalities (176 from Collins Chabane and 404 from Thulamela municipalities respectively). The sample size determination for the study will be computed based on the formula:

$$n = \frac{N}{Ne^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where n is the desired sample size; N is the total target population; e is the degree of accuracy required normally set at 0.05 (5% of acceptable sampling error) (Kothari, 2004; Asfaw et al., 2017). Therefore, from each sub-group, a simple random sampling technique will be used to select a total of 319 smallholder farmers (121 from Collins Chabane municipality and 198 from Thulamela municipality). For this study, respondents were asked if they were willing to pay for extension services. (No [0], yes [1]); smallholder farmers were asked to rank the level of frequency extension personnel farm visits (weekly [0], monthly [1], quarterly [2], annually [3], never [4]); respondents were asked about the extension feedback (extension feedback takes too long [0], extension feedback does not take too long [1]).

5.3 Ethics statement

The ethics statement is presented in chapter 3 (3.3).

5.4 Methods of analysis

Data were gathered via survey questionnaires, which were coded by giving each response a numerical code. Statistical Package for Social Scientists (SPSS) version 26 and stataSE 17 software was used to collect and analyze the data. The study's data on smallholder farmers were mostly summarized using frequencies and percentages. Using SPSS, the Shapiro-Wilk test was used to determine whether the explanatory factors were normal before the variables were analysed. According to the test, the data were regarded as normal if the Shapiro-Wilk test's p-value was higher than 0.05. A T-test was used to analyse the descriptive statistics for

continuous variables, through SPSS. The p-values for the T-test were produced by SPSS. The chi-square test was used to analyse the descriptive statistics of categorical variables through SPSS. The SPSS generated the *p*-values throughout the study. The significant levels for the coefficients in the study were categorized into three thresholds of significance for the coefficients in study 1%, 5%, and 10%. For the econometrics modelling, STATA was employed.

5.5 Estimating determinants of smallholder farmers' willingness to pay for extension services: Binary probit regression model

The binary Probit model was employed to determine whether the individual respondent is willing to pay for extension services or not. A Probit model is also called a Probit regression which is used to model a binary response variable. The assumption under this model are: (1) We must have enough data of more than 30 observations, (2) the data is assumed to follow a standard normal, and the error follows the standard normality and lastly (3) the categorical predictors are assumed to have a linear effect on the response variable (Moore, 2013). The model perfectly fits the objective well, as it takes into account where the dependent variable is of two categorical outcomes, willing to pay for extension services or unwilling to pay for extension services which are coded as 1 and 0 respectively. A respondent who was willing to pay for extension services was coded as (1) and unwilling to pay for extension services (0) (Table 5.1).

The model could be econometrically stated as:

$$P_i = F(Z_i) = \frac{1}{1 + e^{-(\alpha + \sum \beta i X_i)}} \qquad (1)$$

Were P_i is the probability that a respondent is willing to pay

X_i represents the ith explanatory variables

α and β_i are regression parameters to be estimated.

e is the base of the natural logarithm

For ease of interpretation of the coefficients, a probit model could be written in terms of the odds and log of odds. The odds ratio is the ratio of the probability that a respondent is willing

to pay for extension services (P_i) to the probability that a respondent is not willing to pay for extension services (1-P_i).

That is, $\left(\frac{P}{1-P}\right) = e^{Z_i}$ (2)

And taking the natural logarithm of equation (2) yields:

$In\left(\frac{P}{1-P}\right) = e^{Z_i} = Z\,i = \alpha + \beta 1\,X_1 + \beta 2\,X_2 + \ldots\ldots + \beta m X_m$ (3)

If the disturbance term Ui is considered, the probit model becomes:

$Z\,i = \alpha + \sum_{i=1}^{m} \beta i\,X_i + Ui$ (4)

Where X_i represents the i[th] predictor variables. The parameters of the model, α and β can be estimated using the maximum likelihood method (Moore, 2013)

Table 5.1:Description of the dependent variable used in the model.

	The binary probit regression model
y = 0	Unwilling to pay for pluralistic extension services
y = 1	Willing to pay for pluralistic extension services

Source: Research survey, 2022.

Table 5.2:Description of independent variables used in the model.

Independent variables	Description and unit of measurement	Expected sign
Age	Categorical, level of household head age in years	+
Gender	Binary, 1 if the head is male and 0 if female	+/-
Marital status	Categorical, marital status of household head	+
Education level	Categorical, educational level of household head	+
Household size	Categorical, level of family size in numbers	-
Land size	Categorical, level of land size in hectares	+
Type of agriculture land farming	Categorical, type of household head production	+
Production purpose	Categorical, production purpose of household head	+
Extension access	Binary, 1 access to extension service and 0 otherwise	-
Frequency extension visit	Categorical, level of extension personnel visits	-
Farming experience	Categorical, level of farming experience of the head in years	+
Extension feedback length	Binary, 1 not too long and 0 otherwise	-
Difference in output	Binary, 1 yes and 0 otherwise	+
Annual income	Total income earned by the household head (R)	+
Privatisation of extension	Binary, 1 yes and 0 otherwise	+
Distance to extension officer	Categorical, distance to extension personnel in km	-
Technology adoption	Categorical, distance to extension personnel in km	+

Note: + means the variable is expected to have a positive effect on the dependent variable; - means the variable is expected to have a negative effect on the dependent variable. Source: Research survey, 2022.

5.6 Results

5.6.1 Descriptive Statistics

The description of the study area is presented in Chapter 3 (3.2.1).

5.6.2 Extension services smallholder farmers are willing to pay.

Figure 5.1 shows that 97% of smallholder farmers in the study area were willing to pay for information and communication technology, and 3% of the smallholder farmers were not willing to pay for information and communication technology. In the study, 36% of the respondents agreed to pay for personal visits and training by extension personnel, while 64% of the respondents did not agree to pay for personal visits and training by extension personnel. In the study, 77% of the respondents agreed to pay for crop and livestock inputs, while 33% of the respondents did not agree to pay for crop and livestock inputs. The study shows that 80% of the smallholder farmers were willing to pay for marketing skills, while 20% of the smallholder farmers were not willing to pay for marketing skills.

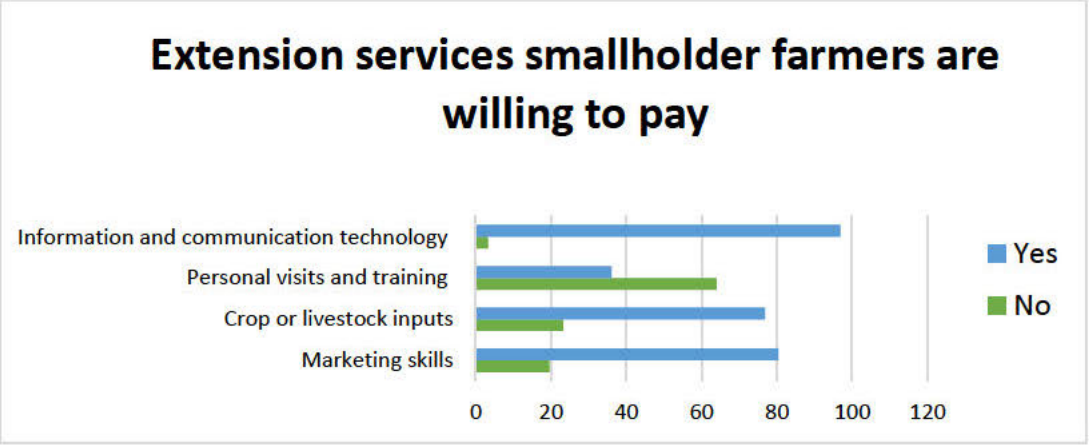

Figure 5.1:Extension services smallholder farmers are willing to pay. Source: Research survey, 2022.

Table 5.3 presents the T-test results of continuous variables. A statically significant relationship exists between the willingness of smallholder farmers to pay for extension services and the annual income of the smallholder farmers ($p<0.01$). The T-test indicated that smallholder farmers who were willing to pay for extension services had a total mean average of R20801.23, and smallholder farmers who were not willing to pay for extension services had a total mean average of R16 810.37.

Table 5.3:T-test results for smallholder farmers' willingness to pay for extension services determinants.

Variable (Mean)	Measure	The willingness of smallholder farmers to pay for extension services	*p*-value
Annual income (ZAR)	No	20801.23	***
	Yes	16810.37	
Household size	No	5.44	ns
	Yes	5.33	

Note: *** mean the coefficient is statistically significant at 1% level. ns= not statistically significant. Source: Research survey, 2022.

Table 5.4 presents the chi-square test results of the categorical variables. A statically significant relationship exists between the smallholder farmers willing to pay for extension services and the age of the smallholder farmers ($p<0.1$). Table 5.4 shows that 33.3% of the smallholder farmers under the age of 25 or 25 were not willing to pay for extension services and 66.7% were willing to pay for extension services. In the category of smallholder farmers who were between the ages of 26 and 35, (14.3%) of the smallholder farmers were not willing to pay for extension services and 85.7% were willing to pay for extension services. In the category of smallholder farmers who were between the ages of 36 and 45, 25.9% of the smallholder farmers were not willing to pay for extension services and 74.1% were willing to pay for extension services. In the category of smallholder farmers who were between the ages of 46 and 55, 20.5% of the smallholder farmers were not willing to pay for extension services and 79.5% were willing to pay for extension services. In the category of smallholder farmers who were between the ages of 56 and 65, 13.5% of the smallholder farmers were not willing to pay for extension services and 86.5% were willing to pay for extension services. In the category of smallholder farmers who were between the ages of 66 and more, 32.1% of the smallholder farmers were not willing to pay for extension services and 67.9% were willing to pay for extension services.

A statically significant relationship exists between the smallholder farmers willing to pay for extension services and the farm size of the smallholder farmers ($p<0.05$). The results indicated

that 36.8% of the smallholder farmers were not willing to pay for extension services with less than 1 hectare and 63.2% were willing to pay for extension services. In the category of 1 hectare, 14.4% of the smallholder farmers were not willing to pay for extension services and 85.6% were willing to pay for extension services. In the category of 1 and 5 hectares, 28.4% of the smallholder farmers were not willing to pay for extension services and 71.6% were willing to pay for extension services. The results further indicated that 14.3% of smallholder farmers with a farm size greater than 5 were not willing to pay for extension services, and 85.7% were willing to pay for extension services.

A statically significant relationship existed between the smallholder farmers willing to pay for extension services and the agricultural production purpose of the smallholder farmers ($p<0.01$). The results indicated 4.7% of livestock smallholder farmers were not willing to pay for extension services and 95.3% were willing to pay for extension services. The results indicated that crop smallholder farmers, 33.1% of the smallholder farmers were not willing to pay for extension services and 66.9% were willing to pay for extension services. The results indicated that in mixed farming smallholder farmers, 20.4% of the smallholder farmers were not willing to pay for extension services and 79.6% were willing to pay for extension services.

A statically significant relationship exists between the smallholder farmers willing to pay for extension services and the farming experience of the smallholder farmers ($p<0.05$). The results indicated that of smallholder farmers with a farming experience of fewer than 10 years, 31.8% of the smallholder farmers were not willing to pay for extension services and 68.2% were willing to pay for extension services. In the category of 11 and 20 years of farming experience, 13.1% of the smallholder farmers were not willing to pay for extension services and 86.9% were willing to pay for extension services. In the category of 21 and 30 farming experience, 19.7% of the smallholder farmers were not willing to pay for extension services and 80.3% were willing to pay for extension services. Smallholder farmers with a farming experience greater than 31 years, 29% of the smallholder farmers were not willing to pay for extension services and 71% were willing to pay for extension services.

As shown in Table 5.4, a statically significant relationship exists between the smallholder farmers willing to pay for extension services and the difference in production output ($p<0.01$). The results indicated that of smallholder farmers with no difference in production output, 13.5% of the smallholder farmers were not willing to pay for extension services and 86.5%

were willing to pay for extension services. Of smallholder farmers who identified a difference in production output, 40.2% of the smallholder farmers were not willing to pay for extension services and 59.8% were willing to pay for extension services.

A statically significant relationship exists between the smallholder farmers willing to pay for extension services and the technology adaption ($p<0.01$). The results indicated that for smallholder farmers who had a low technology adaption, 18.5% of the smallholder farmers were not willing to pay for extension services and 81.5% were willing to pay for extension services. Smallholder farmers who had a low technology adaption, 23.5% of the smallholder farmers were not willing to pay for extension services and 76.5% were willing to pay for extension services. Smallholder farmers who had a high technology adaption, 4.3.6% of the smallholder farmers were not willing to pay for extension services and 56.4% were willing to pay for extension services.

Table 5.4:Association between willingness to pay for extension services and socioeconomic parameters.

Variable	Measure	Unwillingness to pay for extension services *n*= 73 (%)	Willingness to pay for extension services *n*=246 (%)	X^2 sig. level
Age	<25	4 (34.3)	8 (66.7)	
	26-35	5 (14 3)	30 (85.7)	
	36-45	14 (25.9)	40 (74.1)	*
	46-55	18 (20.5)	70 (79.5)	
	56-65	7 (13 5)	45 (86.5)	
	66>	25 (32.1)	53 (67.9)	
Gender	Male	31 (24.2)	97 (75.8)	ns
	Female	42 (22.0)	149 (78.0)	
Marital status	Single	19 (21 1)	71 (78.9)	
	Married	32 (21.5)	117 (78.5)	
	Divorced	4 (26.7)	11 (73.3)	ns
	Widowed	18 (27.7)	47 (72.3)	
Educational level	Never attended	8 (22.9)	27 (77.1)	
	Primary school	14 (18.4)	62 (81.6)	ns
	Secondary school	39 (26.7)	107 (73.3)	
	Tertiary	12 (19.4)	50 (80.6)	
Farm size	<1 hectare	21 (36.8)	36 (63.2)	
	1 hectare	21 (14.4)	125 (85.6)	**
	1-5 hectare	29 (28.4)	73 (71.6)	
	5>	2 (14.3)	12 (85.7)	
Type of agricultural land farm	Dry land agriculture	24 (19.8)	97 (80.2)	ns
	Irrigated land agriculture	49 (24.7)	149 (60.6)	
Production purpose	Livestock	3 (4.7)	61 (95.3)	
	Crop	47 (33.1)	95 (66.9)	***
	Mixed farming	23 (20.4)	90 (79.6)	
Extension access	No	6 (8.7)	63 (91.3)	
	Yes	67 (26.8)	183 (73.2)	
Frequency extension visit	Weekly	4(28.6)	10 (71.4)	
	Monthly	33 (39.8)	50 (60.2)	
	Quarterly	12 (21.8)	43 (78.2)	
	Annually	11 (14.5)	65 (85.5)	
	Never	13 (14.3)	78 (85.7)	
Farming experience	<10	27 (31.8)	58 (68.2)	
	11-20	13 (13.1)	86 (86.9)	**
	21-30	13 (19.7)	53 (80.3)	
	31>	20 (29.0)	49 (71.0)	
Extension feedback length	Too long	31 (16.3)	159 (83.7)	ns
	Not too long	42 (32.6)	87 (67.4)	
Differences in production output	No	28 (13.5)	179 (86.5)	***
	Yes	45 (40.2)	67 (59.8)	
Privatisation of extension	No	27(79.4)	7 (20.6)	ns
	Yes	46 (16.1)	239 (83.9)	
Distance to extension officer	1-5	40 (32.3)	84 (67.7)	
	6-10	12 (46.2)	14 (53.8)	ns
	11-15	9 (10.2)	79 (89.8)	
	16>	12 (14.8)	69 (85.2)	
Technology adoption	low	36 (18.5)	159 (81.5)	
	Average	20 (23.5)	65 (76.5)	***
	High	17 (43.6)	22 (56.4)	

Note: Figures in parentheses are percentages. ***, ** and * mean the coefficient is statistically significant at 1%, 5% and 10% level. ns= not statistically significant. *n* = sample size. X^2= chi-square. Source: Research survey, 2022.

Table 5.5 displays the results of the variables' multicollinearity test, along with the variance inflation factor (VIF) for each variable. The variables showed a high level of tolerance, which suggested that there was no significant multicollinearity among the variables employed in the analysis. Both the Nagelkerke R square and the Cox and Snell square lacked statistical significance. This demonstrated that the data for this investigation suited the model effectively.

Table 5.5:Multicollinearity Test for explanatory variables.

Variables	Collinearity statistics	
	Tolerance	**Variance inflation factor (VIF)**
Age	0.375	2.668
Gender	0.856	1.169
Marital status	0.694	1.441
Education level	0.686	1.458
Household size	0.977	1.024
Land size	0.913	1.096
Type of agriculture land farming	0.293	3.410
Production purpose	0.813	1.230
Extension access	0.391	2.560
Frequency extension visit	0.411	2.435
Farming experience	0.462	2.164
Extension feedback length	0.388	2.574
Difference in output	0.399	2.507
Annual income	0.842	1.187
Privatisation of extension	0.679	1.474
Distance to extension officer	0.463	2.159
Technology adoption	0.833	1.201

Source: Research survey, 2022.

The determinants smallholder farmers' willingness to pay for extension services in the study areas were estimated using a binary probit model (Table 5.6). The findings show that all calculated coefficients are statistically significant due to the statistical significance of the LR X2 statistic ($p<0.01$). The size of the impact of the explanatory variables is not depicted by the coefficients of the binary probit model. The marginal effects are instead discussed. The

marginal effects measure how a change in the average value of the independent variables, expressed as a unit, affects the likelihood that a respondent in the study will pay for extension services or not.

Table 5.6:Binary probit results of determinants of smallholder farmers' willingness to pay for extension services.

Independent variables	Coefficients	Robust Std. Error	Marginal Effects
Age	-0.007	0.096	-0.002
Gender	0.086	0.201	0.023
Marital status	-0.159	0.100	-0.043*
Education level	-0.107	0.125	-0.028
Household size	-0.039	.003	-0.010
Land size	0.315	0.122	0.085***
Type of agriculture land farming	0.207	0.337	0.056
Production purpose	-0.206	0.197	-0.055
Extension access	-0.408	0.356	-0.110
Frequency extension visit	0.008	0.105	0.002
Farming experience	0.022	0.113	0.006
Extension feedback	-0.092	0.271	-0.024
Difference in output	0.628	0.264	0.169**
Annual income	-5.46×10^{-6}	6.17×10^{-6}	-1.48×10^{-6}
Privatisation of extension	1.508	0.333	0.408***
Distance to extension officer	0.234	0.134	0.063**
Technology adoption	0.023	0.134	-0.006
Constant	0.226	0.852	
Number of observations=319, LR X^2 = 88.41 ***, Pseudo R^2= 0.25			

Note: ***, ** and * means the coefficient is statistically significant at 1%, 5% and 10% levels, respectively. Source: Research survey, 2022.

5.7 Discussion

The binary probit model, as shown in Table 5.6, indicated that marital status was found to have a negative and statistically significant impact on the willingness to pay for extension services among smallholder farmers in the study area. The marginal effects showed that the marital status of smallholder farmers had a 4.3% lower chance of smallholder farmers being willing to pay for extension services. A plausible explanation could be that smallholder farmers who are not married cannot afford to pay for extension without the aid of a counterpart. These results were consistent with the finding of Ejeta et al. (2019), who stated that households with spouses

had higher incomes and were willing to pay more for improved irrigation water than single farming households with lower incomes in Ethiopia.

The results in table 5.6, showed that there was a statistically significant and positive relationship between land size and the willingness to pay for extension services among smallholder farmers. The marginal effect showed that a one-unit increase in the land of a smallholder farmer resulted in an 8.5 % higher chance of respondents paying for extension services. A probable reason is that when a farmer is willing to pay for extension services, smallholder farmers can invest in expanding their land size so that they can achieve maximum production. Farmers who are willing to pay for extension services can go the extra mile to achieve farming benefits. The findings are consistent with the findings of Daniel and Teferi (2015) and Loki et al. (2019).

Differences in smallholder farmers' output production had a positive and statistically significant impact on the willingness to pay for extension services among smallholder farmers in the study area. The marginal effects showed that the difference in output showed smallholder farmers had a 16.9 % higher chance of smallholder farmers willing to pay for extension services. A plausible explanation could be that for a farmer willing to pay for extension services, production will increase due to the availability of skilled extension personnel.

The study hypothesised that the implementation of a privatising government extension service influences the willingness of smallholder farmers to pay for extension services. The results in Table 5.6 show a statistically significant and positive relationship between the privatisation of extension and the willingness to pay for extension services among smallholder farmers. The marginal effects indicated that the privatisation of extension services had a higher chance of 4.8% of smallholder farmers willing to for extension services. This result suggests that the implementation of privatising the government extension service encourages smallholder farmers to pay for the extension and have. Furthermore, smallholder farmers and private extension personnel can make a contract that is result oriented. The results build on the existing evidence by (Loki et al., 2019) that farmers favoured the privatisation of extension. Farmers maintained that if the agricultural extension were privatized, they would be responsible for paying for those services. According to a study (Labarthe and Laurent, 2013; Loki et al., 2019), privatizing extension services would reduce wasteful government spending, do away with the top-down approach, boost efficiency, and raise the standard of extended services offered.

The distance to extension personnel increased the probability of smallholder farmers paying for extension services. The marginal effect showed that the distance to extension personnel led to a 0.6% higher chance of smallholder farmers in the study area paying for extension services. The implication is that respondents who are willing to pay for extension services are likely to increase their production with the availability of farming equipment, production methods and the availability of advanced information communication technology, however, this could only favour smallholder farmers who are closer to the extension source. However, the study's results do not support the existing evidence by Gosbert et al. (2019) and Santuah et al. (2022), who indicated that the distance to the extension source negatively influences smallholder farmers' willingness to pay for extension services. A likely explanation is that farmers find it more expensive and time-consuming to get to the extension sources since rural roads are in such poor shape.

5.8 Conclusion and policy implications

The study aimed to analyse the determinants of smallholder farmers' willingness to pay for extension services in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province in South Africa. The binary probit regression model revealed that marital status negatively influenced the probability of smallholder farmers' willingness to pay for extension services in the study area. While land size, the difference in output, privatisation of extension and distance to extension personnel positively influenced the probability of smallholder farmers' willingness to pay for extension services in the study area. Based on these findings, this study recommends that both the public and private stakeholders encourage good quality production and access to the local market, contracts and privatising the government extension service to provide quality extension services. Young farmers should be the objective of extension services to secure their financial viability. The amount of money farmers are willing to spend on extension services is heavily influenced by household income, farm size, and household size. The commercialization of extension services could be improved by focusing on farmers with high levels of income, large farm holdings, and small household sizes. However, it's important to take care to address impoverished, large-family, and small-landholding households equally.

This study only used the binary probit model to analyse the determinants of smallholder farmers' willingness to pay for extension services in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The study should be supplemented with ongoing research or studies that use other tools for smallholder farmers' willingness to pay for outsourced extension services so that a more comprehensive conclusion can be drawn, this would include:

- These private sectors should normalise publishing the costs of the services they want to charge for customers to cater for farmers.
- Extension service providers must understand the maximum amount consumers are willing to pay so that they can devise an optimal pricing strategy that can maximize profits and simultaneously satisfy consumers.
- Capacity building on current affairs concerning the agricultural extension and the environment.

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CHAPTER 6 AN ANALYSIS OF THE DETERMINANTS INFLUENCING THE USAGE OF DIFFERENT EXTENSION SERVICES IN VHEMBE DISTRICT, SOUTH AFRICA

ABSTRACT

Extension services facilitate better technological choices and diversification of farming activities. However, the public sector delivery of extension services has been ineffective and continues to hamper the success of smallholder farmers. There is little attention in research to guide agricultural extension and rural development policymakers regarding factors influencing smallholder farmers' reformation of public extension service and their impact towards a sustainable extension system in Vhembe district, Limpopo Province is scarce. The study provides evidence that was carried out to analyse the determinants influencing a sustainable extension system in Thulamela and Collins Chabane Municipality, Vhembe District of Limpopo Province. Data were collected from 319 smallholder farmers through a probability sampling method involving a stratified and simple random sampling technique. The data was analysed using the multinomial logistic model. Among the variables considered in the multinomial logistic model, gender ($p<0.1$), household size ($p<0.1$), farm size ($p<0.1$), willing to pay for extension service ($p<0.01$), extension feedback length ($p<0.01$), the difference in output ($p<0.1$), annual income ($p<0.01$) and effectiveness of extension ($p<0.1$) were found to significantly influence smallholder farmers performance. The study recommends that public and private stakeholders should collaborate and continuous education, workshops and refresher courses be offered for extension officers.

Keywords: Thulamela and Collins Chabane Municipalities; extension strategies; private sector; public sector; multiple extension sources

6.1 Introduction

Numerous studies have been conducted on the contribution of smallholder agricultural development to efforts to reduce rural household poverty and food insecurity (World Bank, 2007; Baiyegunhi et al., 2019). Smallholder agricultural growth is still a major option in low-income nations; this could be accomplished by improving the supply of farmer support services such as educational training, social capital, loan access, rural infrastructures, and extension services (Baiyegunhi et al., 2019). Promoting agricultural and rural development has been regarded as critically dependent on agricultural extension services.

Similar to other developing nations, South Africa's government offers farmers extension assistance (Loki et al., 2020). Typical agricultural extension services include strengthening innovation processes, creating connections between farmers and other organizations, developing capacity through training, and assisting in bolstering farmers' bargaining position through appropriate institutional and organizational development (Machila et al, 2015). Through raising awareness, disseminating information, and providing training, extension services also help farmers make better technology decisions and diversify their farming operations, which both improve agricultural output and household income (Baiyegunhi et al., 2019).

Many governments chose to assume exclusive responsibility for implementing agricultural extension services due to the 'public good' component of these activities (Lyne et al., 2018). However, the government, through the department of agriculture, is primarily responsible for delivering agricultural extension services in South Africa, where about four million people are involved in both subsistence and commercial agriculture. Only a small portion of these farmers receive any kind of extension support (Baiyegunhi et al., 2019). However, the delivery of extension services by the public sector has been ineffective (Loki et al., 2020). In particular, government extension services must overcome obstacles including facilitating land reform, securing funding, and coming up with enough programs that concentrate on the growth of smallholder farmers (Baiyegunhi et al., 2019). Smallholder farmers are more vulnerable to risk and uncertainty due to bureaucratic inefficiencies in the public sector when they are in the dark regarding climate change impact, inputs, management techniques, and market hazards (Aker,

2011). The farmer may be able to lower their production and market risks if they have access to and are proficient with current information (Aker, 2011).

The public sector has exacerbated the issue of low finance for extension, which has led to poor service delivery that directly affects the productivity of smallholder farmers (Loki et al., 2020). The agricultural extension sector is currently confronting several issues, including a high extension-to-farmer ratio, the firing of trained and experienced staff, and the lack of basic resources including transportation, inputs, and pertinent agricultural knowledge (Afful and Lategan, 2014).

The participation of non-government parties to satisfy farmers' information needs has undergone the most significant transformation (Lyne et al., 2018). Private services providers, such as agribusiness companies, non-governmental organizations (NGOs), and farmers' organizations, deliver outsourced extension services after winning contracts from the government or donors. Uganda was the first nation in sub-Saharan Africa (SSA) to test outsourced extension services, according to Benin et al. (2011). Beginning in 1990, further pilot initiatives were started in Tanzania, Mali, and Mozambique (Swanson and Rajalahti 2010). Although agribusiness companies and NGOs carried out these pilot projects, funders and national governments jointly funded them. The national governments of these nations are expanding their outsourced extension activities (Swanson and Rajalahti 2010). Of Mozambique's 128 rural districts in 2009, 91 of them were served by NGOs, and 50 of them by private businesses (Lyne et al., 2018).

However, recent empirical literature to guide agricultural extension and rural development policymakers regarding the factors influencing smallholder farmers' reformation of the public extension service and their impact towards a sustainable extension system in the Vhembe District of Limpopo Province in South Africa is scarce. Hence, this study factors influencing a sustainable extension service system among smallholder farmers in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The hypothesis was that the pluralistic extension service provider is efficient and financially sustainable for providing services to farmers compared to the public extension service provider. To test our hypothesis, we used a parametric One-Way ANOVA for continuous variables and a chi-square test for categorical variables to indicate the association between smallholder farmers' performance with different economic parameters. Furthermore, the multinomial logistic regression model was

used to analyse factors influencing a sustainable extension service system among smallholder farmers.

6.2 Materials and methods

6.2.1 Description of the study area

The description of the study area is presented in Chapter 3 (3.2.1).

6.2.2 Data collection

Data were collected from 319 from a population size of 580 smallholder farmers through a probability sampling method involving a stratified and simple random sampling technique. A pre-tested questionnaire was used as a primary data collection tool for the study. The questionnaire was administered by well-trained enumerators using face-to-face interviews with the respondents. In a questionnaire-based survey, a total of 191 women and 128 men participated. A total of 19 female smallholder farmers and male smallholder farmers participated in four focus group discussions (FGDs). The FGDs were randomly selected participants who did not participate in the questionnaire interview. The four FDGs were divided into two groups of female smallholder farmers and two groups of male smallholder farmers to access full participation from female smallholder farmers in the absence of male smallholder farmers.

However, before collecting data in the study area, a probability sampling method involving a stratified random technique were used to select farmers. Farmers in the Vhembe District were divided into 2 sub-group municipalities (176 from Collins Chabane and 404 from Thulamela municipalities respectively). The sample size determination for the study will be computed based on the formula:

$$n = \frac{N}{Ne^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where n is the desired sample size; N is the total target population; e is the degree of accuracy required normally set at 0.05 (5% of acceptable sampling error) (Kothari, 2004; Asfaw et al., 2017). Therefore, from each sub-group, a simple random sampling technique were used to

select a total of 319 smallholder farmers (121 from Collins Chabane municipality and 198 from Thulamela municipality). For this study, the smallholder farmers were asked to select the kind of extension service they preferred. Positive responses were coded as Yes [1] and if not, it was coded as No [0]. Smallholder farmers were asked if there were willing to pay for extension services. Positive responses were coded as Yes [1] and if not, it was coded as No [0]. Respondents were asked about the effectiveness of the extension. Positive responses were coded as Yes [1] and if not, it was coded as No [0].

6.3 Ethics statement

The ethics statement is presented in chapter 3 (3.3).

6.4 Methods of analysis

Data were gathered via survey questionnaires, which were coded by giving each response a numerical code. Statistical Package for Social Scientists (SPSS) version 28 and stataSE 17 software was used to collect and analyze the data. The study's data on smallholder farmers were mostly summarized using frequencies and percentages. Using SPSS, the Shapiro-Wilk test was used to determine whether the explanatory factors were normal before the variables were analysed. According to the test, the data were regarded as normal if the Shapiro-Wilk test's p-value was higher than 0.05. A One-Way Analysis of Variance (ANOVA) parametric test was used to analyze the descriptive statistics for continuous variables. The *p*-values were generated by SPSS for a one-way ANOVA parametric test. The ANOVA parametric test was validated by the following conditions: the variables were checked and satisfied normality, the variance in the samples was approximately equal, and the data were randomly and independently sampled from the population. The chi-square test was used to analyze the descriptive statistics of categorical variables through SPSS. The SPSS generated the *p*-values throughout the study. The significant levels for the coefficients in the study were categorized into three levels: 1%, 5%, and 10%. STATA was used for econometrics modelling.

6.5 Estimating factors influencing a sustainable extension system among smallholder farmers in Vhembe District: Multinomial logistic regression model

The interest of the study was to identify factors influencing smallholder farmers' selection of the kind of extension service and their impact towards a sustainable extension system in Vhembe District. Therefore, Multinomial logistic regression was the chosen econometric model for this purpose. The choice of a given extension provider is discrete as it is chosen amongst other alternatives (Verbeek, 2004). Let P_{ij} represent the probability of choice of any given extension service provider by farmers, then the equation representing this will be:

$Pij = \beta_0 + \beta_1 X_1 + ... + \beta_k X_k + e$ ..... (1)

Where i takes values (0, 1, 2…), each representing the choice of extension providers (Public extension = 0, Private sector = 1, Multiple sources of extension = 2). X_1 are factors affecting the use of different extension services, β are parameters to be estimated, and e is a randomised error.

With j choices, the probability of choosing extension provider j is given by:

$$\text{Prob}\,(Yi=j) = \left(\frac{e_{zj}}{\Sigma_{k=0} e_{zk}}\right) \quad \text{.....(2)}$$

Where Z_j is a choice and Z_k is a choice that could be chosen (Greene, 2000). The model estimates are used to determine the probability of using different extension services j factors that affect the choice X_i. With a number of choices, the log odds ratio is computed as:

$$ln\left(\frac{P_{ij}}{P_{ij}}\right) = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X3 + \cdots + \beta_k X_k + \mathrm{e}_i \quad \text{..... (3)}$$

Pij and Pik are probabilities that a farmer will choose a given extension service and alternative extension respectively. $lnPijPij$ is a natural log of the probability of choice J relative to probability choice k, a is a constant, β is a matrix of parameters that reflect the impact of changes in X on the probability of choosing a given outlet, is the error term that is independent and normally distributed with a mean zero. The parameter estimates of the Multinomial logit model provide only the direction of the effect of the independent variable on the dependent (response) variable but do not represent the actual magnitude of change or probabilities. The marginal effects or marginal probabilities are functions of the probability itself and measure

the expected change in the probability of a particular choice being made with respect to a unit change in an independent variable from the mean (Greene, 2000).

Marginal effects of the attributes on choice are determined by getting the differential of the probability of a choice and it is given by:

$$\delta = \frac{\partial \mathrm{Pi}}{\partial \mathrm{Xi}} = pi(\beta_j - \sum_{k=0}^{j} P_k \beta_k) = Pi(\beta j - \beta) \ldots \ldots \quad (4)$$

The MNL model was as follows:

$$yi = ln\left(\frac{P_{ij}}{P_{ij}}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots \ldots \beta_n X_n + Ri + \mathcal{E}t \ldots \ldots \quad (5)$$

Where Yi = different extension services (public extension services, private sector extension, multiple extension services), β = coefficient vectors of independent variables, and Xi, where i = 1, 2, 10, are explanatory variables.

Table 6.1:Description of the dependent variable used in the model.

Choices of the source of extension service (J):
j_1 = Public sector
j_2 = Private sector
j_3 = Multiple sources of extension

Source: Research survey, 2022.

Table 6.2 Description of variables used in the Multinomial logit regression model.

Variables	Description and unit of measurement	Expected sign
Age	Categorical, level of household head age in years	+
Gender	Binary, 1 if the head is male and 0 if female	+/-
Marital status	Categorical, marital status of household head	+
Education level	Categorical, educational level of household head	+
Household size	Categorical, level of family size in numbers	+
Farm size	Categorical, level of land size in hectares	+
Willing to pay for extension service	Binary, 1 if yes and 0 otherwise	+
Extension feedback	Binary, 1 Extension feedback length and 0 otherwise	+
Difference in output	Binary variable, 1 if yes and 0 otherwise	-
Annual income	Total income earned by the household head (R)	+
Privatisation of extension	Binary, 1 if yes and 0 otherwise	-
Effectiveness of extension	Binary, 1 if extension services are effective and 0 otherwise	-
Technology adoption	Binary, 1 if the household head adapts well to technology and 0 otherwise	-

Note: + means the variable is expected to have a positive effect on the dependent variable; - means the variable is expected to have a negative effect on the dependent variable. Source: Research survey, 2022.

6.6 Results

6.6.1 Descriptive Statistics

The description of the study area is presented in Chapter 3 (3.2.1).

6.6.2 Smallholder farmers' choice of extension service.

Figure 6.1. shows that 75% of the smallholder farmers in the study area were able to adapt to the public sector as their extension service provider, 5%of the smallholder farmers were able to adapt to the private sector as their extension service provider and 20% of the smallholder farmers were able to adapt to multiple sources of extension as their service provider.

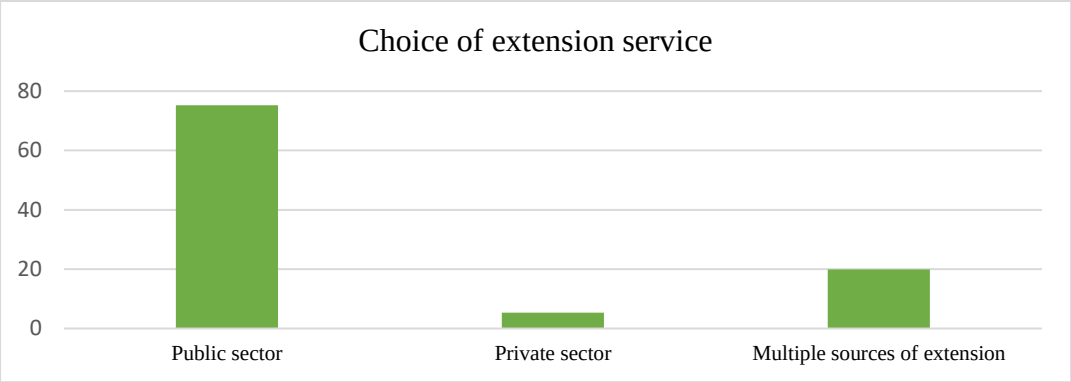

Figure 6.1:Choice of extension service adopted by smallholder farmers. Source: Research survey, 2022.

Table 6.3. presents the parametric One-way ANOVA results of continuous variables. The household size of the smallholder farmers was statistically significantly different across the extension service providers ($p<0.05$). The ANOVA indicated that smallholder farmers with a mean household size of 5 members received their extension services from the public sector, those who had a mean household size of 4 members received their extension services from the private sector, and smallholder farmers who had a mean household size of 6 members received their extension services from multiple sources of extension service providers.

Table 6.3:Parametric One-Way ANOVA results for smallholder farmers' determinates.

Variable (Mean)	Public sector	Private sector	Multiple sources of extension	*p*-value
Annual income (ZAR)	19175.88	17007.65	12298.40	ns
Household size	5.24	4.76	6.0	**

Note: ** mean the coefficient is statistically significant at a 5% level. ns= not statistically significant. Source: Research survey, 2022.

Table 6.4 presents the chi-square test results of the categorical variables. A statically significant relationship exists between the sources of extension service providers influencing a sustainable extension service system and the age of the smallholder farmers ($p<0.1$). Table 6.4 shows that 4.2% of the smallholder farmers aged 25 or less received extension services from the public sector, none of the respondents aged 25 or less received extension services from the private sector and 3.2% received extension services from multiple sources of extension providers. In the category of smallholder farmers who were between the ages of 26 and 35, 8.8% received extension services from the public sector, 23% received extension services from the private sector, and 16.1% received extension services from multiple sources of extension providers. In the category of smallholder farmers who were between the ages of 36 and 45, 17.1% received extension services from the public sector, 17.6% received extension services from the private sector, and 16.1% received extension services from multiple sources of extension providers. In the category of smallholder farmers who were between the ages of 46 and 55, 25.8% received extension services from the public sector, 11.8% received extension services from the private sector, and 38.7% received extension services from multiple sources of extension providers. In the category of smallholder farmers who were between the ages of 56 and 65, 17.9% received extension services from the public sector, 29.4% received extension services from the private sector, and 6.5% received extension services from multiple sources of extension providers. In the category of smallholder farmers who were between the ages of 66 and more, 26.3% received extension services from the public sector, 17.6% received extension services from the private sector, and 19.4% received extension services from multiple sources of extension providers.

A statically significant relationship, as shown in Table 6.4 was found between the sources of extension service providers influencing a sustainable extension service system and the gender of the smallholder farmers ($p<0.1$). The results indicated that 37.9% of male smallholder farmers received extension services from the public sector, 29.4% received extension services from the private sector, and 51.6% received extension services from multiple sources of extension providers. The results indicated that 62.1% of female smallholder farmers received extension services from the public sector, 70.6% received extension services from the private sector, and 48.4% received extension services from multiple sources of extension providers.

A statically significant relationship, as shown in Table 6.4 was found between the sources of extension service providers influencing a sustainable extension service system and the farm size of the smallholder farmers ($p<0.01$). The results indicated that of smallholder farmers with a farm size of less than a hectare, 20.4% received extension services from the public sector, 11.8% received extension services from the private sector, and 9.7% received extension services from multiple sources of extension providers. In the category of 1 hectare, 35.4% received extension services from the public sector, 47.1% received extension services from the private sector, and 85.5% received extension services from multiple sources of extension providers. In the category of 1 and 5 hectares, 38.8% received extension services from the public sector, 41.2% received extension services from the private sector, and 3.2 % received extension services from multiple sources of extension providers. The results further indicated that 5.4% of smallholder farmers with a farm size greater than 5 hectares received extension services from the public sector, not received extension services from the private sector, and 1.6% received extension services from multiple sources of extension providers.

A statically significant relationship, as shown in Table 6.4 was found between the sources of extension service providers influencing a sustainable extension service system and extension feedback length from extension personnel ($p<0.1$). The results indicated that smallholder farmers who received extension feedback on time by personnel received 56.3% extension services from the public sector, 70.6% received extension services from the private sector, and 64.5% received extension services from multiple sources of extension providers. The results indicated that smallholder farmers who did not receive extension feedback on time by personnel received 43.8% of extension services from the public sector, 35.3% received

extension services from the private sector, and 29% received extension services from multiple sources of extension providers.

A statically significant relationship, as shown in Table 6.4 was found between the sources of extension service providers influencing a sustainable extension service system and privatisation of extension ($p<0.01$). The results indicated that smallholder farmers who disagreed with the privatisation of extension, received 13.8% of extension services from the public sector, none of the smallholder farmers received extension services from the private sector, and 1.6% received extension services from multiple sources of extension providers. The results indicated that smallholder farmers who agreed with the privatisation of extension, received 86.3% of extension services from the public sector, 100% received extension services from the private sector, and 96.8% received extension services from multiple sources of extension providers.

A statically significant relationship, as shown in Table 6.4 was found between the sources of extension service providers influencing a sustainable extension service system and technology adoption ($p<0.05$). The results indicated that smallholder farmers with a low technology adoption received 57.9% of extension services from the public sector, 47.1% received extension services from the private sector, and 77.4% received extension services from multiple sources of extension providers. The results indicated that smallholder farmers with an average technology adoption received 29.6% of extension services from the public sector, 29.4% received extension services from the private sector, and 14.5% received extension services from multiple sources of extension providers. The results indicated that smallholder farmers with a high technology adoption received 12.5% of extension services from the public sector, 23.5% received extension services from the private sector, and 8.1% received extension services from multiple sources of extension providers.

Table 6.4:Association between factors influencing a sustainable extension service system among smallholder farmers and socioeconomic parameters.

Variable	Measure	Public sector *n*= 240 (%)	Private sector *n*=17 (%)	Multiple sources of extension *n*=62	X^2 sig. level
Age	<25	10 (4.2)	0 (0)	2 (3.2)	
	26-35	21 (8.8)	4 (23.5)	10 (16.1)	
	36-45	41 (17.1)	3 (17.6)	10 1(6.1)	*
	46-55	62 (25.8)	2 (11.8)	24 (38.7)	
	56-65	43 (17.9)	5 (29.4)	4 (6.5)	
	66>	63 (26.3)	3 (17.6)	12 (19.4)	
Gender	Male	91 (37.9)	5 (29.4)	32 (51.6)	*
	Female	149 (62.1)	12 (70.6)	30 (48.4)	
Marital status	Single	70 (29.2)	6 (35.3)	14 (22.6)	
	Married	108 (45.0)	6 (35.3)	35 (56.5)	
	Divorced	10 (4.2)	1 (5.9)	4 (6.5)	ns
	Widowed	52 (21.7)	4 (23.5)	9 (14.5)	
Educational level	Never attended	28 (11.7)	2 (11.8)	5 (8.1)	
	Primary school	58 (24.2)	3(17.6)	15 (24.2)	ns
	Secondary school	112 (46.7)	9 (52.9)	25 (40.3)	
	Tertiary	42 (17.5)	3 (17.6)	17 (27.4)	
Farm size	<1 hectare	42 (20.4)	2 (11.8)	6 (9.7)	
	1 hectare	85 (35.4)	8 (47.1)	53 (85.5)	***
	1-5 hectare	93 (38.8)	7 (41.2)	2 (3.2)	
	5>	13 (5.4)	0 (0)	1 (1.6)	
Extension feedback length	Not too long	135 (56.3)	11 (64.7)	44 (71.0)	*
	Too long	105 (43.8)	6 (35.3)	18 (29.0)	
Differences in production output	No	155 (64.6)	12 (70.6)	40 (64.5)	ns
	Yes	85 (35.4)	5 (29.4)	22 (35.5)	
Willing to pay for extension service	No	67 (27.9)	0 (0)	6 (9.7)	
	Yes	173 (72.1)	17 (100)	56 (90.3)	
Privatisation of extension	No	33 (13.8)	0 (0)	1 (1.6)	***
	Yes	207 (86.3)	17 (100)	61 (98.4)	
Effectiveness of extension	No	159 (66.3)	12 (70.6)	60 (96.8)	
	Yes	81 (33.8)	5 (29.4)	2 (3.2)	
Technology adoption	low	139 (57.9)	8 (47.1)	48 (77.4)	
	Average	71 (29.6)	5 (29.4)	9 (14.5)	**
	High	30 (12.5)	4 (23.5)	5 (8.1)	

Note: Figures in parentheses are percentages. ***, ** and * mean the coefficient is statistically significant at 1%, 5% and 10% level. ns= not statistically significant. *n* = sample size. X^2= chi-square. Source: Research survey, 2022.

Table 6.5 displays the results of the variables' multicollinearity test, along with the variance inflation factor (VIF) for each variable. The variables showed a high level of tolerance, which suggested that there was no significant multicollinearity among the variables employed in the analysis. Both the Nagelkerke R square and the Cox and Snell square lacked statistical significance. This demonstrated that the data for this investigation suited the model effectively.

Table 6.5:Multicollinearity test for explanatory variables.

Variables	Collinearity statistics	
	Tolerance	**Variance inflation factor (VIF)**
Age	0.601	1.665
Gender	0.883	1.132
Marital status	0.693	1.444
Education level	0.694	1.441
Household size	0.980	1.020
Farm size	0.918	1.089
Willing to pay for extension service	0.713	1.402
Extension feedback length	0.452	2.210
Difference in output	0.479	2.089
Annual income	0.914	1.095
Privatisation of extension	0.619	1.616
Effectiveness of extension	0.558	1.792
Technology adoption	0.816	1.226

Source: Research survey, 2022.

The elements that smallholder farmers consider while selecting an extension service are shown in Table 6.6. As the LR X2 statistic is statistically significant ($p < 0.01$), the findings show that all computed coefficients are statistically significant. Based on marginal effects, significant variables were interpreted. The coefficients of independent variables and the binomial and polynomial responses of the dependent variables do not have a complete meaning for interpretation other than to reflect the direction of the relationship.

Table 6.6:Multinomial logistic results of factors influencing a sustainable extension service system among smallholder farmers.

Independent variables	Private sector			Multiple sources of extension		
	Coef.	Std. Err.	ME	Coef.	Std. Err.	ME
Age	-0.146	0.250	-0.050	-0.153	0.143	-0.013
Gender	0.538	0.611	0.0230	0.588	0.342	0.051*
Marital status	0.075	0.283	0.020	0.239	0.187	0.020
Education level	0.051	0.341	0.011	0.221	0.225	0.019
Household size	0.117	0.132	0.005	0.127	0.070	0.011*
Farm size	0.138	0.367	0.069	-0.416	0.228	-0.036*
Willing to pay for extension service	0.05167	0.862	0.006	1.078	0.582	0.093***
Extension feedback length	-0.533	0.985	-0.001	-1.808	0.683	-0.158***
Difference in output	0.410	1.005	0.073	2.270	0.705	0.198*
Annual income	9.87×10^{-7}	0.001	6.33×10^{-10}	0.027	0.001	2.37×10^{-6}***
Privatisation of public extension	0.156	0.006	0.005	1.509	1.306	0.131
Effectiveness of extension	-0.052	0.830	0.001	-2.733	0.851	-0.239*
Technology adoption	0.722	0.410	0.028*	0.031	0.295	0.002
Constant	-0.339	0.0787		-0.323	1.671	

The number of observations =319. LR X^2 = -174.65***, Pseudo R^2 = 0.20. The reference category is Public-sector. ME = Marginal Effect.

Note: *** and * means the coefficient is statistically significant at 1% and 10% levels respectively. Research survey, 2022.

6.7 Discussion

Women contribute significantly to the economy through their work as business owners, farm workers, employees, or through unpaid domestic caregiving. When it comes to growing, processing, and marketing food, female farmers in Africa perform the majority of the work (Olumeh, 2021). In contrast to men, women produce between 60 and 80 percent of the world's food and are burdened with unpaid labour, time flexibility, limited access to agricultural inputs, and lower salaries. Therefore, strengthening the voice and visibility of African women in the agricultural sciences is crucial for effectively addressing their objectives and concerns (Connor and San, 2021; Olumeh, 2021). As shown in table 6.4, the results showed that there was a statistically significant and positive relationship between the gender of the respondents and the related to use of different extension sources that make pluralistic extension service systems efficient and financially sustainable in use for smallholder farmers. Table 6.6 also showed that the gender of the respondents significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple sources of extension strategies increases by a factor of 0.051 as the gender of smallholders increases by 1. A possible explanation is that males and females are given an equal opportunity to participate or use different extension sources. However, the study's results did not support existing evidence by Connor and San (2021), their findings showed that gender had a negative relationship between gender and the source of extension. A possible explanation is that when women are employed outside the household farming they receive less pay than men, and when identifying themselves as farmers, they have restricted access to inputs and loans. Furthermore, agricultural extension services and equipment are perceived as being designed for and used by men.

As shown in table 6.3, the results showed that there was a statistically significant and positive relationship between the household size of the respondents and the related to use of different extension sources. Table 6.6 also showed that the household size of the respondents significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple extension sources increases by a factor of 0.011 as the household size increases by 1. When the

household size is bigger, it will positively contribute towards farmers' production as the will be more persons involved from the household with the same goal towards the farm. When multiple sources of extension provide extension services, these people come together and discuss the obstacles and find solutions promptly.

As shown in table 6.4, the results showed a statistically significant and negative relationship between the farm size of the respondents and the related use of different extension sources. Table 6.6 also showed that the farm size of the respondents significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households participating in multiple sources of extension strategies decreases by a factor of 0.036 as the farm size of smallholder farmers increases by 1. A possible explanation could be that farmers had a limitation of funds or resources which would not allow them to expand their production, therefore, the use of different extension sources that makes pluralistic extension service systems efficient and financially sustainable in use for smallholder farmers.

Table 6.6 also showed that smallholder farmers' willingness to pay for extension services significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple extension sources increases by a factor of 0.093 as willing to pay for extension service of smallholder farmers is increases by 1. A possible explanation is that smallholder farmers in the study area who are willing to pay for extension services have a variety of extension services providers to choose from. They have an option of receiving a second opinion and are not restricted to dwell on the public extension service provider.

These results were consistent with the demand theory, which states that when household income rises, farmers' capacity to buy more goods rises as well (Gebreegziabher and Mezgebo, 2020). Higher-income households are more prepared to pay for extension services since they are no longer under as much financial pressure (Ejeta, 2019). As a result, the amount that households are willing to pay is based on their degree of income. This suggests that if farmers receive higher benefits from commercial extension services, they will be more likely to pay for extension (Gebreegziabher and Mezgebo, 2020). Feedback is crucial since it aids farmers in

better understanding the many limits they face and offers more knowledge on what inputs to purchase or tactics to employ to address pressing issues (Loki et al., 2020). As shown in table 6.4, the results showed that there was a statistically significant and negatively relationship between the extension feedback length of the

respondents and the related to use of different extension sources. Table 6.6 also showed that the extension feedback length of the respondents significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple extension sources decreases by a factor of 0.158 as the feedback of smallholder farmers increases by 1. The rationale behind this result is that the turn around time of feedback is too long, resulting in a negative contribution towards the farm production and the service would no longer have the impact as compared to it being rendered in time. Therefore, using different extension sources would not make pluralistic extension service systems efficient and financially sustainable for smallholder farmers. These results were consistent with those of Loki et al. (2020), who asserted that a farmer may move away from one extension source and toward other sources of information if they believe several sources can provide feedback more quickly owing to competition from other sources. This might result from too many different approaches to a single issue, making it difficult for a farmer to choose the best and most sustainable answer. Additionally, a farmer could defer applying the knowledge while they await input from other sources (Loki et al., 2020).

Table 6.6 also showed that the difference in the output of the respondents significantly and positively influenced the participation in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple extension sources increases by a factor of 0.198 as the difference in the output of smallholder farmers increases by 1. The probable reason behind this result is that smallholder farmers who have access to multiple extension service providers can quickly address issues as they do, thus minimizing the delay to implement an intervention.

Table 6.6 also showed that the extension annual income of the respondents significantly and positively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio

in favour of the probability of the households to participate in multiple extension sources increases by a factor of 2.37 $\times 10^{-6}$ as the Annual income of farmworkers increases by 1. The rationale behind this result is that smallholders who have income see the value of their farming production and with income readily available, farming can expand. Therefore, making pluralistic extension service systems efficient and financially sustainable in use for smallholder farmers.

Table 6.6 also showed that the effectiveness of the extension of the respondents significantly and negatively influenced the participants in implementing the use of multiple extension sources. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in multiple extension sources decreases by a factor of 0.239 as the effectiveness of extension of smallholder farmers increases by 1. The rationale of this result is that smallholder farmers' expectations are sometimes not met immediately. At some point, extension officers need time to research the query a smallholder farmer would have raised.

As shown in table 6.4, the results showed that there was a statistically significant and positive relationship between the technology adoption of the respondents and the related use of different extension sources. Table 6.6 also showed that the Technology adoption of the respondents significantly and positively influenced the participants in implementing the use of the private sector. Interpretation of the odds ratio depicted that, if other factors are held constant, the odds ratio in favour of the probability of the households to participate in the private sector increases by a factor of 0.028 as the technology adoption of smallholder farmers' use increases by 1. The probable reason could be that the multiple uses of extension officers would help the farmer to adopt the technologies faster and use them towards better farming methods and higher production. However, the results of this study did not support the existing evidence by Fadare et al. (2014). Fadare et al. (2014) reported a negative relationship between technology adoption and extension service provider. A possible explanation is the low adoption rate of better crop technologies is that there has been insufficient research and farmer engagement.

6.8 Conclusion and policy implications

The aim of the study identifies factors that make extension service systems efficient and financially sustainable in use for smallholder farmers in Thulamela and Collins Chabane municipalities of Vhembe District, South Africa. The results of the multinomial logistic regression model revealed that farm size, extension feedback length, and effectiveness of extension negatively influenced a sustainable extension service system among smallholder farmers in the study area. Gender, household size, willingness to pay for extension service and the difference in output and annual income positively influenced a sustainable extension service system among smallholder farmers in the study area. Based on the study's findings, farm size lowered the respondents' sustainable extension service system among smallholder farmers. The study concluded that the agricultural public sector cannot stand alone to sustain livelihoods, reduce poverty and achieve food security for the irrigation farmworkers in the study area. The conclusion is based on the study's hypothesis, the results showed that pluralistic extension service provider is efficient and financially sustainable for providing services to farmers compared to the public extension service provider. Based on the findings, the study recommends that public and private stakeholders should collaborate and have an alliance to meet the needs of smallholder farmers.

Analysing factors influencing an efficient and financially sustainable extension service system among smallholder farmers is a composite subject whose accomplishment can be measured or carried out using various analytical tools such as the multinomial logistic model and the double bound logit model. This study only used the multinomial logistic model to analyse factors that influence a sustainable pluralistic extension service system among smallholder farmers in Thulamela and Collins Chabane Municipalities, Vhembe District of Limpopo Province. The study should be supplemented with studies that use other tools for smallholder farmers' performance so that a more comprehensive conclusion can be drawn.

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CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The general objective of the study is to determine the main constraints to the provision of extension services on smallholder farmers in Thulamela and Collins Chabane Municipality, of Vhembe District, South Africa. Therefore, this chapter presents concluding remarks and recommendations based on the study's main findings. The main findings of each objective of the study are described in the subsequent sections of this chapter.

7.2 A synopsis of the purpose of the study

7.2.1 Literature review: To review the existing literature regarding agricultural extension reformation.

The global effort that began late in the 20th century to restructure the national extension systems in developing nations has given agricultural extension a new dimension. As the globe enters an era of globalization, democracy, privatization, and decentralization that affects smallholder farmers in poor nations, new learning needs of farming communities are arising. The purpose of this chapter was to reflect on efforts to define and disseminate practices, strategies and approaches to establish efficient, effective and financially stable agricultural extension services in South Africa. The approach used to review the literature on modernizing agricultural extension is to transform and modernize the extension system to play a stronger, more enhanced role in increasing farm income and enhancing the livelihoods of the rural poor**.** The findings identified weak extension services limit the ability for potentially beneficial agricultural innovation and market opportunities to reach smallholder farmers in South Africa. This paper concluded that before the instigation of reforming the agricultural extension system, the reformation of agricultural extension system should have a clear understanding of the needs of farmers before providing services. The practical implication is that the article concludes with a call for studies to evaluate its impact on the performance of smallholder farmers they seek to serve, to inform policies about its need, impact and effectiveness. Sustainable agricultural development can be achieved by applying extension approaches and models that are considered appropriate for smallholder farmers' needs, increasing farmers' basic knowledge and ability to

make their own sound choice of specific technologies. The study provided four directions for future research. These directions are:

- Very few African countries are consolidating their extension service systems through the application of a pluralistic extension system due to the constraints encountered in the public sector. Therefore, studies should be done on the impact of privatization when establishing methods of coordinating the quality of services provided to the smallholder farmers in the extension system.
- The establishment of the methods developed through privatization in South Africa should consider their technical staff or capacity to deliver the services.
- Studies should also consider the conditions of how should pluralism to extension workers operate efficiently. Information and communication technology has the potential the reform a public extension system.
- Future research should focus on information and communication technology in South Africa as an extension method approach. Where it can be appropriate, efficient and financially sustainable when addressing the constraints faced by rural smallholder farmers.

7.2.2 Objective 1: To evaluate the impact of the current agricultural extension service delivery on smallholder farmers' performance.

The study evaluated the impact of the current agricultural extension service delivery on smallholder farmers' performance. The multiple linear regression model was used to analyse factors that influence smallholder farmers' performance. Credit access, access to public extension, extension feedback and transparency and accountability negatively influenced the performance of smallholder farmers in the study area. While gender and access to privatised extension positively influenced the performance of smallholder farmers in the study area. Based on the study's findings, credit access lowered the respondents' performance. By implication, the study recommends that public and private stakeholders should ease credit access for smallholder farmers by creating accessible micro-lending depots for smallholder farmers which will allow farmers to borrow money and low-interest rates and with reasonable collaterals. Farmers' cooperatives may also assist in bargain lending where farmers may lend and purchase farm inputs for the best farm performance. Based on the study's findings, poor

extension feedback lowered the respondents' performance. By implication, the study recommends that public and private stakeholders should encourage the establishment of farmers' committees.

7.2.3 Objective 2: To examine the knowledge and perception of implementing a pluralistic extension system among smallholder farmers.

The study examined the knowledge and perception of implementing a pluralistic extension system among smallholder farmers. A binary probit regression model was used to analyse factors influencing the perception of implementing a pluralistic extension system among smallholder farmers. The age negatively influenced the probability of implementing a pluralistic extension system among smallholder farmers in the study area. While the difference in production output, level of extension effectiveness, pluralistic extension knowledge, technology adoption and distance to extension personnel positively influenced the probability of implementing a pluralistic extension system among smallholder farmers in the study area. By implication, the study recommends the government should improve farming with regards to the mechanization of farming activities to attract young graduates into the sector.

7.2.4 Objective 3: To analyse the determinants of smallholder farmers' willingness to reform from public extension services to private extension services.

The study analysed the determinants of smallholder farmers' willingness to reform from public extension services to private extension services. A binary probit regression model was used to analyse the determinants of smallholder farmers' willingness to pay for extension services. The marital status negatively influenced the probability of smallholder farmers' willingness to pay for extension services in the study area. While land size, the difference in output, privatisation of extension and distance to extension personnel positively influenced the probability of smallholder farmers' willingness to pay for extension services in the study area. Based on these findings, this study recommends that both the public and private stakeholders should encourage good quality production and access to the local market, contracts and privatising the government extension service for the provision of quality extension services. Young farmers

should be the objective of extension services to secure their financial viability. The amount of money farmers willing to spend on extension services is heavily influenced by household income, farm size, and household size. The commercialization of extension services could be improved by focusing on farmers with high levels of income, large farm holdings, and small household sizes. However, it's important to take care to address impoverished, large-family, and small-landholding households equally.

7.2.5 Objective 4: To identify factors that make extension service systems efficient and financially sustainable in use for smallholder farmers.

The study identified factors that make extension service systems efficient and financially sustainable in use for smallholder farmers. The multinomial logistic regression model was used to analyse factors influencing a sustainable extension service system among smallholder farmers. The farm size, extension feedback length, and effectiveness of extension negatively influenced a sustainable extension service system among smallholder farmers in the study area. While gender, household size, willingness to pay for extension service and the difference in output and annual income positively influenced a sustainable extension service system among smallholder farmers in the study area. By implication, the study recommends that public and private stakeholders should insure land availability and ownership are easily accessible to smallholder farmers. Based on the study's findings, extension feedback length lowered the respondents' sustainable extension service system among smallholder farmers. By implication, the study recommends that public and private stakeholders should establishment of committees, farmers' study groups and commodity groups / for easy access to information dissemination and feedback. Based on the study's findings, the effectiveness of extension lowered the respondents' sustainable extension service system among smallholder farmers. By implication, the study recommends that public and private stakeholders should collaboration and continuous education, workshops and refresher courses for extension officers.

7.3 Conclusions

In conclusion, there is need for a collaboration between all stakeholders involved in agricultural development and among the farmers themselves. The collaboration between the farmers will promote farmer-to-farmer learning. Farmers will share their successes and failure on that platform. This may stimulate transparency where farmers may be able to take accountability without the aid of an extension service provider. Farmers can share challenges they encounter and the applied based on their experience. The collaboration between stakeholders will assist farmers in their different needs, for example, different service providers like water services, environmental services, engineers, extension services and many others may offer essential services which farmers may use towards their success. The collaboration between extension officer and farmers will help farmers to get access to information such as how to access credit or capital, how to farm productively and how to have access to local and national markets. Furthermore, extension officers need to undertake monitoring options such as farm record books that include both traditional hard-copy approaches and new computer-assisted systems.

Given that public extension officers are found to have been assigned to too many smallholder farmers which results in them giving minimal assistance, as compared to a private extension officer who is paid for and is directly accountable to the single farmer that paid for the service or would possibly be paid based on the result. As a result, it observed that private extension offices provide better services as compared to public extension offices. This shows that it is the most significant that the public sector and private sector actively collaborate at all times towards helping smallholder farmers.

Access to public extension officers was found to negatively affect the performance of smallholder farmers. Therefore, for farming to be feasible and actively demand-driven by smallholder farmers, the public extensions service provides should provide services that are related to the demand. This may be achieved through public extension officers' receiving refresher courses through the department. The department can establish an investment drive to help the smallholder farmers to get access to capital and a market establishment drive. For a pluralistic extension service system to be implemented and be demand-driven by smallholder farmers, the public extension officers need to implement a strict performance contract that will ensure that their agricultural farming production is outcome-based. Doing so will ensure that

all stakeholders involved show commitment to their specific tasks towards rural development and focus on the interest of smallholder farmers.

7.4 Recommendations

This study was conducted among smallholder farmers in Thulamela and Collins Chabane Municipality, of Vhembe District, Limpopo Province. Therefore, the study findings cannot be used to draw conclusions or generalizations for all smallholder farmers in South Africa. Based on the study's findings, the study recommends the following:

7.4.1 Recommendations for action:

- Decentralization of staff and administrative accountability to regional or local entities. If carried out properly and if local government is adequately funded. A public service bureaucracy's top-down structure can change as a result of decentralization.
- Pluralistic arrangements have the potential to aid in resolving universal issues by involving a range of stakeholders in the creation of contracts and cooperative partnerships.
- Skills development programmes such as refresher courses for public extension officers. Extension officers can establish and focus commodity groups based on their proficiency.
- Commitment in the form of performance contracts between extension and farmers needs to be implemented

7.4.2 Policy recommendations:

- The Department of Agriculture should introduce a farmer support policy. These policies should be made known to smallholder farmers through awareness creation by extension officers. Farmers should take lead in the department of agriculture policy development.
- The policy should stipulate how private and public extension sectors should operate or approach smallholder farmers to avoid conflict and passive criticism by the end user.

7.4.3 Recommendations for future research:

- Needs to look at the roles of public and private extension services in community development.
- An impact evaluation should be done to measure the relation between extension activity and changes in farmers' awareness and adoption of particular technologies.

APPENDICES

APPENDIX A: RESEARCH QUESTIONS

Ethical clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

13 September 2021

Miss Rudzani Vhuyelwani Angel Mudzielwana (218087064)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Miss Mudzielwana,

Protocol reference number: HSSREC/00003210/2021
Project title: Towards developing a pluralistic agricultural extension system in Vhembe District of Limpopo Province, South Africa.
Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 04 August 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 13 September 2022.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

D A ENT OF
AGRICULTURE AND RURAL DEVELOPMENT

Ref: 12R
Enquiries: Dr T. Raphulu 19 July 2021

Mudzielwana Rudzani (218087064)
UKZN

RE: APPLICATION TO CARRY OUT RESEARCH UNDER THE DEPARTMENT OF AGRICULTURE & RURAL DEVELOPMENT, VHEMBE DISTRICT.

1. Your letter/email dated 15/07/2021 of request for permission to do research has reference.

2. Kindly take note that your request to conduct research titled "*TOWARDS DEVELOPING A PLURALISTIC AGRICULTURAL EXTENSION SYSTEM: IN THE CASE OF VHEMBE DISTRICT OF LIMPOPO PROVINCE, SOUTH AFRICA.*", has been granted. The permission to conduct research in the Vhembe District is valid from 26th July 2021 to 31st March 2022.

3. You are required to contact the office of the Director: Vhembe District to brief them on the study, to request key informants database (community leaders, managers, extension officers and farmers) and the assistance.

4. The Research team is required to conform to lockdown regulations in order to mitigate the spread of COVID 19.

5. The Department is prepared to embark on any activity that could assist our farmers to improve their farming systems and production at large.

6. Kindly take note that you will be expected to hand over a copy of your final report to the Department for record purposes as well as for reporting. You may also be invited to share your findings in the Departmental Research Forum.

7. Hoping that you will find this in order.

Kind regards

[redacted]

19/07/2021

Dr. T. Raphulu
Chairperson: Research Committee

Date

67/69 Biccard Street, POLOKWANE, 0700, Private Bag X9487, Polokwane, 0700
Tel. (015) 294 3135 Fax: (015) 294 4512 Website: http //www.lda.gov.za

INFORMED CONSENT LETTER FOR RESPONDENTS ALONG VHEMBE DISTRICT

Dear Sir/Madam

My name is Rudzani Vhuyelwani Angel Mudzielwana, a Doctor of Philosophy student in Agricultural Extension and Rural Resource Management student under the College of Agriculture, Engineering and Science in University of KwaZulu Natal, under the supervision of Professor P. L. Mafongoya, Dr Phophi M.M and Mngomezulu S.

I am conducting a study that seeks to identify the constraints to provision of extension services and develop a pluralistic agricultural extension system in the four municipalities of Vhembe District: Collins Chabene, Makhado, Musina and Thulamela municipality, respectively. The study will use the following research tools to obtain the required information:

- Survey
- Questionnaires
- Focus group discussions

It is essential to know that:

- Participation in this study is voluntary, you can stop participating at any time during the study,
- There will be no payment for participating in the study,
- All information will be kept confidential and will only be used for the purpose of this study,
- Overtime, the information provided will be destroyed when deemed necessary.

For further information about the study please contact the researcher or the study supervisors:

CONTACT DETAILS:

1. Rudzani V.A Mudzielwana: Email:vhuyelwani@gmail.com: phone: 082 555 9870
2. Professor P. L. Mafangoya: Email: mafongoya@ukzn.co.za: Phone: 033 260 5464
3. Dr Phophi MM: Email: mutondiwa@gmail.com : Phone: 065 904 1499
4. Dr Mngomezulu S: Email: mngomezulus2@ukzn.ac.za: Phone: 076 410 7850

or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

CONSENT

I…… have been informed about the study entitled "Towards Developing A Pluralistic Agricultural Extension System: In the case of Vhembe District of Limpopo Province, South Africa" area by Rudzani V.A Mudzielwana.

- I understand the purpose and procedures of the study. I have been given an opportunity to answer questions about the study and will answer to my satisfaction.
- I declare that my participation in this study is entirely voluntary and that I may withdraw at any time.
- If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at 082 555 9870 or vhuyelwani@gmail.com

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

…….. ……

Signature of Participant Date

SEMI-STRUCTURED INTERVIEW GUIDE FOR FARMERS

The information captured in this questionnaire is strictly confidential and will be used for research purposes by staff and students at the KwaZulu-Natal ONLY. Respondents can choose not to answer questions – answers are voluntary.

Research Title: Towards developing a pluralistic agricultural extension system in Vhembe District of Limpopo Province, South Africa

Date of survey:	Municipality name:	Name of enumerator:

Section A: demographic information of farmers

1. Age of respondent in years

(0) ≤25<	(1) 25- 35	(2) 35 - 45	(3) 45 - 55	(4) 55 - 65	(5) 66

2. Gender of respondent

(0) Female	(1) Male

3.Marital status of respondent

(0) Single	(1) Married	(3) Divorced	(4) Widowed

4. What is the educational level of the respondent?

(0) No education	(1) Primary school	(2) Secondary school	(3) Tertiary

5. Household size

No.

Section B: Farmers farming circumstances

1. Farm size in Hectares

(0) less than 1	(1) 1-5	(2) More than 5

2. Farming experience in years

(0) less than 10	(1) 10 - 15	(2) 25- 35	(3)35 - 45	(4) 45 - 55	(5) 55 - 65	(6) 66

3. Type of farmer

(0) Part- time farmer	(1) Full-time farmer

(0) Subsistence farmer	(1) Commercial farmer

4. Production

Farmer's production	Yes (1) No (0)	List them	Purpose of production (0)Household consumption (1) Sale purposes (2) Both
Crops production			
Horticulture production			
Livestock production			

5. Microfinance characteristics

Have a loan	(0) N0	(1) Yes	
Other income resources	(0) No	(1) Yes	
Late payment of input at the end of season	(0) No	(1) Yes	
Income satisfaction	(0) Insufficient	(1) Moderate	(2) Satisfied

Section C: Farmer's perception of agricultural extension services

1. Do you have any knowledge regarding a pluralistic extension system or privatisation of the public sector

(0) No	(1) Yes

2. Source of extension service

(0) Public sector	(1) Private sector	(2)Third sector i.e., NGOs/FBOs	(3) Other (mention)

3. Period of extension contact in years ?_____

4. Frequency of extension visit

(0) Weekly	(1) Monthly	(2) Quarterly	(3) Annually	(4)Never

5. Satisfied with extension visit

(0) Satisfied	(1) Not satisfied

6. How long does it take to receive feedback?

(0) Too long	(1) Not too long

7. How satisfied are you with the impact of the feedback on your production?

(0) Poor	(1) Average	(2) Good	(3) Excellent

8. Which extension mode do you prefer

(0) Individual	(1) Group	(2) Mass media

9. Willing to participate in privatisation of extension services

(0) No	(1) Yes

10.

Support/ services offered by extension officer	**Yes(1) No(0)**	**Rank SEE CODES BELOW**
Information support		
Credit and insurance facilities		

Inputs (seeds, machinery)		
Infrastructure (cold storage, feed mixing)		
Market (market yard, transportation)		
Other:		

Rank codes: Rarely (0) Sometimes (1) Often (2) Always (3)

Section D: Farmer's evaluation on extension models

1.

Extension service methods applied by farmer	**No (0) Yes (1)**	**Indicate the extent to which you agree with the statement. SEE CODES BELOW**	**SOURCE**
1. Individual agricultural extension methods			
Farm visits			
Office calls			
letters			
2. Mass media extension methods			
Television			
Radio			
Newspaper			
3. Group method of extension			
Group meetings			
Demonstrations			
Field days			
Methods demonstration			
District agricultural fairs			
Farm walks			
Farmers rallies			
Folk meetings			
Group meetings			

Motivational tours			
Participatory technology development			
Formal training days			
Farmer field schools			

Rank codes: Rarely (0) Sometimes (1) Often (2) Always (3)

Source: (0) public sector (1) private sector (2) both

2. Technology adoption rate by farmer

(0) low	(1) Average	(2) High

Section E: Farmer's willingness to pay for extension services

a. Farmer's projection of paid extension services

1. Willing to pay and share costs among farmers for extension services?

(0) No	(1) Yes

2. Service types expected

(0) Information only	(1) Information, inputs, and marketing	(2) Other (specify)

3. Extension mode preference

(0) Individual	(1) Framers group	(2) Farms associations

4. Frequency

(0) Weekly	(1) Monthly	(2) Quarterly	(3) Annually

5. Total annual income earned from agricultural produce

R……

Thank you for your time
Aah!

APPENDIX B: MULTIPLE LINEAR REGRESSION RESULTS ON SMALLHOLDER FARMERS' PERFORMANCE.

```
. regress ANNUAL_INCOME AGE GENDER MARITAL_STATS EDU_LEVEL HOUSEHOLD_SIZE LAND_SIZE CREDIT
> _ACCESS MARKET_ACCESS EXTENSION_ACCESS FARMING_EXPERIENCE EXTENSION_FEEDBACK TRANSPARENC
> Y_AND_ACCONYTABILITY
```

Source	SS	df	MS		
Model	1.8007e+10	12	1.5006e+09	Number of obs	= 319
Residual	1.5244e+11	306	498158608	F(12, 306)	= 3.01
				Prob > F	= 0.0005
Total	1.7044e+11	318	535986088	R-squared	= 0.1056
				Adj R-squared	= 0.0706
				Root MSE	= 22319

ANNUAL_INCOME	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
AGE	798.5133	1415.572	0.56	0.573	-1986.974	3584.001
GENDER	5114.013	2718.233	1.88	0.061	-234.7812	10462.81
MARITAL_STATS	-616.379	1414.943	-0.44	0.663	-3400.628	2167.87
EDU_LEVEL	488.629	1672.531	0.29	0.770	-2802.489	3779.747
HOUSEHOLD_SIZE	379.4328	546.6539	0.69	0.488	-696.2436	1455.109
LAND_SIZE	895.5042	1630.685	0.55	0.583	-2313.271	4104.279
CREDIT_ACCESS	9052.274	4055.356	2.23	0.026	1072.361	17032.19
MARKET_ACCESS	-4014.01	3853.336	-1.04	0.298	-11596.4	3568.379
EXTENSION_ACCESS	7561.935	3320.066	2.28	0.023	1028.887	14094.98
FARMING_EXPERIENCE	-908.9099	1656.341	-0.55	0.584	-4168.169	2350.349
EXTENSION_FEEDBACK	-12641.12	3090.467	-4.09	0.000	-18722.37	-6559.863
TRANSPARENCY_AND_ACCO~Y	-3223.261	1518.573	-2.12	0.035	-6211.428	-235.0949
_cons	17426.89	8839.241	1.97	0.050	33.50134	34820.28

```
. margins, dydx (*) atmeans

Conditional marginal effects                                    Number of obs = 319
Model VCE: OLS

Expression: Linear prediction, predict()
dy/dx wrt:  AGE GENDER MARITAL_STATS EDU_LEVEL HOUSEHOLD_SIZE LAND_SIZE CREDIT_ACCESS
            MARKET_ACCESS EXTENSION_ACCESS FARMING_EXPERIENCE EXTENSION_FEEDBACK
            TRANSPARENCY_AND_ACCONYTABILITY
At: AGE                               =  3.15047 (mean)
    GENDER                            = .5987461 (mean)
    MARITAL_STATS                     = 1.172414 (mean)
    EDU_LEVEL                         = 1.736677 (mean)
    HOUSEHOLD_SIZE                    = 5.354232 (mean)
    LAND_SIZE                         =  1.22884 (mean)
    CREDIT_ACCESS                     = .2727273 (mean)
    MARKET_ACCESS                     =  .338558 (mean)
    EXTENSION_ACCESS                  = .7836991 (mean)
    FARMING_EXPERIENCE                = 1.373041 (mean)
    EXTENSION_FEEDBACK                = .4043887 (mean)
    TRANSPARENCY_AND_ACCONYTABILITY = 2.858934 (mean)
```

	dy/dx	Delta-method std. err.	t	P>|t|	[95% conf.	interval]
AGE	798.5133	1415.572	0.56	0.573	-1986.974	3584.001
GENDER	5114.013	2718.233	1.88	0.061	-234.7812	10462.81
MARITAL_STATS	-616.379	1414.943	-0.44	0.663	-3400.628	2167.87
EDU_LEVEL	488.629	1672.531	0.29	0.770	-2802.489	3779.747
HOUSEHOLD_SIZE	379.4328	546.6539	0.69	0.488	-696.2436	1455.109
LAND_SIZE	895.5042	1630.685	0.55	0.583	-2313.271	4104.279
CREDIT_ACCESS	9052.274	4055.356	2.23	0.026	1072.361	17032.19
MARKET_ACCESS	-4014.01	3853.336	-1.04	0.298	-11596.4	3568.379
EXTENSION_ACCESS	7561.935	3320.066	2.28	0.023	1028.887	14094.98
FARMING_EXPERIENCE	-908.9099	1656.341	-0.55	0.584	-4168.169	2350.349
EXTENSION_FEEDBACK	-12641.12	3090.467	-4.09	0.000	-18722.37	-6559.863
TRANSPARENCY_AND_ACCO~Y	-3223.261	1518.573	-2.12	0.035	-6211.428	-235.0949

APPENDIX C: BINARY PROBIT REGRESSION RESULTS ON IMPLEMENTING A PLURALISTIC EXTENSION SYSTEM.

Probit regression — Number of obs = 319
LR chi2(15) = 112.53
Prob > chi2 = 0.0000
Log likelihood = -51.976626 — Pseudo R2 = 0.5198

PRIVATISATION_OF_EXTE~N	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
KNOWLEDGE_ON_PLURALISM	.611785	.3321679	1.84	0.066	-.0392522	1.262822
DIFFERENCE_IN_OUTPUT	-1.871058	.4977131	-3.76	0.000	-2.846557	-.8955578
AGE	-.3277766	.1640471	-2.00	0.046	-.6493029	-.0062503
GENDER	-.3363806	.318727	-1.06	0.291	-.9610741	.2883128
MARITAL_STATS	.2294686	.169395	1.35	0.176	-.1025395	.5614767
EDU_LEVEL	.0891255	.2036188	0.44	0.662	-.30996	.4882109
HOUSEHOLD_SIZE	.0566317	.0662698	0.85	0.393	-.0732546	.1865181
FARMING_EXPERIENCE	.2242065	.1592289	1.41	0.159	-.0878764	.5362893
EXTENSION_ACCESS	-.7129958	.5702707	-1.25	0.211	-1.830706	.4047142
CREDIT_ACCESS	.6082753	.4812109	1.26	0.206	-.3348808	1.551431
MARKET_ACCESS	-.0192292	.496692	-0.04	0.969	-.9927277	.9542692
EFFECTIVENESS_OF_EXTE~N	.3374375	.4437927	0.76	0.447	-.5323802	1.207255
LEVEL_OF_EFFECTINESS	.6460701	.2311407	2.80	0.005	.1930427	1.099097
TECHNOLOGY_ADOPTION	-.6470349	.2020767	-3.20	0.001	-1.043098	-.2509717
DISTANCE_TO_EXTENSION~E	.3052491	.1518044	2.01	0.044	.0077178	.6027803
_cons	1.839345	1.284457	1.43	0.152	-.6781447	4.356835

```
. margins, dydx (*) atmeans

Conditional marginal effects                                    Number of obs = 319
Model VCE: OIM

Expression: Pr(PRIVATISATION_OF_EXTENSION), predict()
dy/dx wrt:  KNOWLEDGE_ON_PLURALISM DIFFERENCE_IN_OUTPUT AGE GENDER MARITAL_STATS
            EDU_LEVEL HOUSEHOLD_SIZE FARMING_EXPERIENCE EXTENSION_ACCESS CREDIT_ACCESS
            MARKET_ACCESS EFFECTIVENESS_OF_EXTENSION LEVEL_OF_EFFECTINESS
            TECHNOLOGY_ADOPTION DISTANCE_TO_EXTENSION_OFFICE
At: KNOWLEDGE_ON_PLURALISM       = .3134796 (mean)
    DIFFERENCE_IN_OUTPUT         = .3510972 (mean)
    AGE                          =  3.15047 (mean)
    GENDER                       = .5987461 (mean)
    MARITAL_STATS                = 1.172414 (mean)
    EDU_LEVEL                    = 1.736677 (mean)
    HOUSEHOLD_SIZE               = 5.354232 (mean)
    FARMING_EXPERIENCE           = 1.373041 (mean)
    EXTENSION_ACCESS             = .7836991 (mean)
    CREDIT_ACCESS                = .2727273 (mean)
    MARKET_ACCESS                =  .338558 (mean)
    EFFECTIVENESS_OF_EXTENSION   = .2758621 (mean)
    LEVEL_OF_EFFECTINESS         = 1.912226 (mean)
    TECHNOLOGY_ADOPTION          = .5109718 (mean)
    DISTANCE_TO_EXTENSION_OFFICE = 1.394984 (mean)
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
KNOWLEDGE_ON_PLURALISM	.0217337	.0152056	1.43	0.153	-.0080687	.0515361
DIFFERENCE_IN_OUTPUT	-.0664694	.0313884	-2.12	0.034	-.1279896	-.0049493
AGE	-.0116443	.0072426	-1.61	0.108	-.0258394	.0025509
GENDER	-.0119499	.0117138	-1.02	0.308	-.0349086	.0110088
MARITAL_STATS	.0081519	.0069839	1.17	0.243	-.0055363	.02184
EDU_LEVEL	.0031662	.0074214	0.43	0.670	-.0113794	.0177118
HOUSEHOLD_SIZE	.0020118	.0024369	0.83	0.409	-.0027643	.006788
FARMING_EXPERIENCE	.0079649	.0064188	1.24	0.215	-.0046157	.0205456
EXTENSION_ACCESS	-.0253292	.0203839	-1.24	0.214	-.065281	.0146225
CREDIT_ACCESS	.021609	.0203792	1.06	0.289	-.0183335	.0615516
MARKET_ACCESS	-.0006831	.0176869	-0.04	0.969	-.0353488	.0339826
EFFECTIVENESS_OF_EXTE~N	.0119875	.0168714	0.71	0.477	-.0210799	.0450549
LEVEL_OF_EFFECTINESS	.0229517	.013894	1.65	0.099	-.0042802	.0501835
TECHNOLOGY_ADOPTION	-.022986	.0118464	-1.94	0.052	-.0462046	.0002326
DISTANCE_TO_EXTENSION~E	.010844	.0070152	1.55	0.122	-.0029056	.0245936

APPENDIX D: BINARY PROBIT REGRESSION RESULTS OF DETERMINANTS OF SMALLHOLDER FARMERS' WILLINGNESS TO PAY FOR EXTENSION SERVICES.

```
Probit regression                                     Number of obs =    319
                                                      LR chi2(17)   =  88.41
                                                      Prob > chi2   = 0.0000
Log likelihood = -127.37531                           Pseudo R2     = 0.2576
```

WILLINGNESS_TO_PAY	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
TECHNOLOGY_ADOPTION	-.0235817	.1349281	-0.17	0.861	-.288036	.2408726
AGE	-.0074892	.0967097	-0.08	0.938	-.1970367	.1820582
GENDER	.0862135	.2014176	0.43	0.669	-.3085578	.4809848
MARITAL_STATS	-.159175	.1003142	-1.59	0.113	-.3557873	.0374373
EDU_LEVEL	-.1071552	.1256187	-0.85	0.394	-.3533633	.139053
HOUSEHOLD_SIZE	-.0398318	.0393279	-1.01	0.311	-.116913	.0372494
AGRIC_LAND_FARM	.2079047	.3376417	0.62	0.538	-.4538609	.8696703
LAND_SIZE	.3155091	.1226905	2.57	0.010	.07504	.5559781
FARMING_EXPERIENCE	.0223978	.1134219	0.20	0.843	-.1999051	.2447006
EXTENSION_ACCESS	-.4087606	.3561851	-1.15	0.251	-1.106871	.2893493
FREQUENCY_EXTENSION_V~T	.0081781	.1055875	0.08	0.938	-.1987696	.2151258
EXTENSION_FEEDBACK	-.0920904	.2713674	-0.34	0.734	-.6239608	.43978
DIFFERENCE_IN_OUTPUT	-.6281472	.2646231	-2.37	0.018	-1.146799	-.1094954
PRODUCTION_PURPOSE	-.2062695	.1978439	-1.04	0.297	-.5940364	.1814975
ANNUAL_INCOME	-5.46e-06	6.17e-06	-0.88	0.376	-.0000176	6.64e-06
PRIVATISATION_OF_EXTE~N	1.508595	.3337876	4.52	0.000	.8543833	2.162807
DISTANCE_TO_EXTENSION~E	.2347843	.1083225	2.17	0.030	.0224761	.4470924
_cons	.2263304	.8529567	0.27	0.791	-1.445434	1.898095

```
Conditional marginal effects                                  Number of obs = 319
Model VCE: OIM

Expression: Pr(WILLINGNESS_TO_PAY), predict()
dy/dx wrt:  TECHNOLOGY_ADOPTION AGE GENDER MARITAL_STATS EDU_LEVEL HOUSEHOLD_SIZE
            AGRIC_LAND_FARM LAND_SIZE FARMING_EXPERIENCE EXTENSION_ACCESS
            FREQUENCY_EXTENSION_VISIT EXTENSION_FEEDBACK DIFFERENCE_IN_OUTPUT
            PRODUCTION_PURPOSE ANNUAL_INCOME PRIVATISATION_OF_EXTENSION
            DISTANCE_TO_EXTENSION_OFFICE
At: TECHNOLOGY_ADOPTION           = .5109718 (mean)
    AGE                           =  3.15047 (mean)
    GENDER                        = .5987461 (mean)
    MARITAL_STATS                 = 1.172414 (mean)
    EDU_LEVEL                     = 1.736677 (mean)
    HOUSEHOLD_SIZE                = 5.354232 (mean)
    AGRIC_LAND_FARM               = .6206897 (mean)
    LAND_SIZE                     =  1.22884 (mean)
    FARMING_EXPERIENCE            = 1.373041 (mean)
    EXTENSION_ACCESS              = .7836991 (mean)
    FREQUENCY_EXTENSION_VISIT     = 2.460815 (mean)
    EXTENSION_FEEDBACK            = .4043887 (mean)
    DIFFERENCE_IN_OUTPUT          = .3510972 (mean)
    PRODUCTION_PURPOSE            = 1.661442 (mean)
    ANNUAL_INCOME                 = 17723.64 (mean)
    PRIVATISATION_OF_EXTENSION    = .8934169 (mean)
    DISTANCE_TO_EXTENSION_OFFICE  = 1.394984 (mean)
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
TECHNOLOGY_ADOPTION	-.0063779	.0364719	-0.17	0.861	-.0778616	.0651058
AGE	-.0020255	.0261582	-0.08	0.938	-.0532948	.0492437
GENDER	.0233173	.0545683	0.43	0.669	-.0836345	.1302692
MARITAL_STATS	-.0430505	.0270195	-1.59	0.111	-.0960077	.0099067
EDU_LEVEL	-.0289812	.0338316	-0.86	0.392	-.0952899	.0373275
HOUSEHOLD_SIZE	-.0107729	.0106276	-1.01	0.311	-.0316025	.0100567
AGRIC_LAND_FARM	.0562299	.0913599	0.62	0.538	-.1228322	.2352921
LAND_SIZE	.0853326	.0330289	2.58	0.010	.0205972	.1500681
FARMING_EXPERIENCE	.0060577	.0306886	0.20	0.844	-.0540908	.0662062
EXTENSION_ACCESS	-.1105535	.0956664	-1.16	0.248	-.2980561	.0769492
FREQUENCY_EXTENSION_V~T	.0022119	.0285617	0.08	0.938	-.0537681	.0581918
EXTENSION_FEEDBACK	-.0249068	.0733249	-0.34	0.734	-.1686209	.1188073
DIFFERENCE_IN_OUTPUT	-.1698888	.0716048	-2.37	0.018	-.3102316	-.029546
PRODUCTION_PURPOSE	-.0557877	.0536599	-1.04	0.299	-.1609591	.0493838
ANNUAL_INCOME	-1.48e-06	1.68e-06	-0.88	0.378	-4.76e-06	1.81e-06
PRIVATISATION_OF_EXTE~N	.4080148	.0972023	4.20	0.000	.2175018	.5985278
DISTANCE_TO_EXTENSION~E	.0634998	.0292803	2.17	0.030	.0061114	.1208882

APPENDIX E: MULTINOMIAL LOGISTIC RESULTS OF FACTORS INFLUENCING A SUSTAINABLE EXTENSION SERVICE SYSTEM AMONG SMALLHOLDER FARMERS.

Multinomial logistic regression — Number of obs = 319
LR chi2(26) = 90.08
Prob > chi2 = 0.0000
Log likelihood = -174.65598 — Pseudo R2 = 0.2050

EXTENSION_SOURCE	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Public_sector	(base outcome)					
Private_sector						
AGE	-.1466049	.2505561	-0.59	0.558	-.6376858	.344476
GENDER	.5386499	.611416	0.88	0.378	-.6597034	1.737003
MARITAL_STATS	.0754791	.2831696	0.27	0.790	-.4795232	.6304814
EDU_LEVEL	.0510407	.3413138	0.15	0.881	-.6179221	.7200035
HOUSEHOLD_SIZE	-.1170029	.1323797	-0.88	0.377	-.3764623	.1424565
LAND_SIZE	.1383731	.3676807	0.38	0.707	-.5822678	.8590139
EXTENSION_FEEDBACK	-.5333334	.9857809	-0.54	0.588	-2.465428	1.398762
WILLINGNESS_TO_PAY	16.05167	1384.862	0.01	0.991	-2698.227	2730.33
DIFFERENCE_IN_OUTPUT	.4109223	1.005043	0.41	0.683	-1.558925	2.38077
ANNUAL_INCOME	-9.87e-07	.0000176	-0.06	0.955	-.0000355	.0000335
PRIVATISATION_OF_EXTE~N	15.63219	1704.006	0.01	0.993	-3324.158	3355.423
EFFECTIVENESS_OF_EXTE~N	.0523231	.8306909	0.06	0.950	-1.575801	1.680447
TECHNOLOGY_ADOPTION	.7227217	.4100869	1.76	0.078	-.0810339	1.526477
_cons	-33.97739	2195.787	-0.02	0.988	-4337.641	4269.686
Third_sector__NGOs_						
AGE	-.1530188	.1438068	-1.06	0.287	-.434875	.1288374
GENDER	-.5880228	.3429581	-1.71	0.086	-1.260208	.0841627
MARITAL_STATS	.2398237	.1871392	1.28	0.200	-.1269624	.6066098
EDU_LEVEL	.2212118	.2255244	0.98	0.327	-.2208079	.6632314
HOUSEHOLD_SIZE	.1279435	.0702173	1.82	0.068	-.0096799	.2655669
LAND_SIZE	-.4165522	.2280228	-1.83	0.068	-.8634688	.0303643
EXTENSION_FEEDBACK	-1.808562	.6830026	-2.65	0.008	-3.147222	-.4699011
WILLINGNESS_TO_PAY	1.078467	.582862	1.85	0.064	-.0639219	2.220855
DIFFERENCE_IN_OUTPUT	2.270476	.7055929	3.22	0.001	.8875392	3.653412
ANNUAL_INCOME	-.0000271	.0000149	-1.82	0.069	-.0000563	2.14e-06
PRIVATISATION_OF_EXTE~N	1.509097	1.306676	1.15	0.248	-1.051941	4.070135
EFFECTIVENESS_OF_EXTE~N	-2.733595	.8514013	-3.21	0.001	-4.402311	-1.064879
TECHNOLOGY_ADOPTION	-.0319299	.2956728	-0.11	0.914	-.611438	.5475783
_cons	-3.231255	1.671162	-1.93	0.053	-6.506673	.0441622

```
Conditional marginal effects                                    Number of obs = 319
Model VCE: OIM

dy/dx wrt: AGE GENDER MARITAL_STATS EDU_LEVEL HOUSEHOLD_SIZE LAND_SIZE
           EXTENSION_FEEDBACK WILLINGNESS_TO_PAY DIFFERENCE_IN_OUTPUT ANNUAL_INCOME
           PRIVATISATION_OF_EXTENSION EFFECTIVENESS_OF_EXTENSION TECHNOLOGY_ADOPTION

1._predict: Pr(EXTENSION_SOURCE==Public_sector), predict(pr outcome(0))
2._predict: Pr(EXTENSION_SOURCE==Private_sector), predict(pr outcome(1))
3._predict: Pr(EXTENSION_SOURCE==Third_sector__NGOs_), predict(pr outcome(2))

At: AGE                           =  3.15047 (mean)
    GENDER                        = .5987461 (mean)
    MARITAL_STATS                 = 1.172414 (mean)
    EDU_LEVEL                     = 1.736677 (mean)
    HOUSEHOLD_SIZE                = 5.354232 (mean)
    LAND_SIZE                     =  1.22884 (mean)
    EXTENSION_FEEDBACK            = .4043887 (mean)
    WILLINGNESS_TO_PAY            = .7711599 (mean)
    DIFFERENCE_IN_OUTPUT          = .3510972 (mean)
    ANNUAL_INCOME                 = 17723.64 (mean)
    PRIVATISATION_OF_EXTENSION    = .8934169 (mean)
    EFFECTIVENESS_OF_EXTENSION    = .2758621 (mean)
    TECHNOLOGY_ADOPTION           = .5109718 (mean)
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
AGE						
_predict 1	.0134353	.0196426	0.68	0.494	-.0250635	.0519341
_predict 2	-.0000509	.0185687	-0.00	0.998	-.0364448	.0363431
_predict 3	-.0133844	.0133378	-1.00	0.316	-.039526	.0127572
GENDER						
_predict 1	.0512451	.0886109	0.58	0.563	-.1224291	.2249192
_predict 2	.00023	.0839346	0.00	0.998	-.1642787	.1647387
_predict 3	-.051475	.030876	-1.67	0.095	-.1119909	.0090408
MARITAL_STATS						
_predict 1	-.0210031	.0171743	-1.22	0.221	-.0546642	.012658
_predict 2	.0000202	.0073611	0.00	0.998	-.0144073	.0144476
_predict 3	.0209829	.0171664	1.22	0.222	-.0126625	.0546284
EDU_LEVEL						
_predict 1	-.0193666	.020024	-0.97	0.333	-.0586129	.0198797
_predict 2	.0000114	.0041729	0.00	0.998	-.0081672	.0081901
_predict 3	.0193552	.0202359	0.96	0.339	-.0203065	.0590169
HOUSEHOLD_SIZE						
_predict 1	-.0111501	.0191553	-0.58	0.561	-.0486939	.0263937
_predict 2	-.00005	.0182348	-0.00	0.998	-.0357895	.0356896
_predict 3	.0112001	.0064231	1.74	0.081	-.0013889	.0237891
LAND_SIZE						
_predict 1	.0363865	.0347076	1.05	0.294	-.0316391	.1044122
_predict 2	.000069	.0251885	0.00	0.998	-.0492995	.0494375
_predict 3	-.0364555	.0208294	-1.75	0.080	-.0772805	.0043694
EXTENSION_FEEDBACK						
_predict 1	.1583763	.0622771	2.54	0.011	.0363153	.2804373
_predict 2	-.0001382	.0504522	-0.00	0.998	-.0990227	.0987462
_predict 3	-.1582381	.0638635	-2.48	0.013	-.2834082	-.0330679
WILLINGNESS_TO_PAY						
_predict 1	-.0999273	1.615847	-0.06	0.951	-3.266928	3.067074
_predict 2	.0061569	1.802971	0.00	0.997	-3.527602	3.539916
_predict 3	.0937704	.194731	0.48	0.630	-.2878954	.4754362
DIFFERENCE_IN_OUTPUT						
_predict 1	-.1987361	.0618543	-3.21	0.001	-.3199682	-.0775039
_predict 2	.0000737	.0268951	0.00	0.998	-.0526398	.0527871
_predict 3	.1986624	.0689223	2.88	0.004	.0635773	.3337475
ANNUAL_INCOME						
_predict 1	2.37e-06	1.45e-06	1.64	0.101	-4.67e-07	5.21e-06
_predict 2	6.33e-10	2.31e-07	0.00	0.998	-4.52e-07	4.54e-07
_predict 3	-2.37e-06	1.38e-06	-1.72	0.085	-5.07e-06	3.29e-07
PRIVATISATION_OF_EXTE~N						
_predict 1	-.1374472	1.738273	-0.08	0.937	-3.5444	3.269506
_predict 2	.0059788	1.940878	0.00	0.998	-3.798072	3.810029
_predict 3	.1314684	.232329	0.57	0.571	-.3238881	.5868248
EFFECTIVENESS_OF_EXTE~N						
_predict 1	.2390824	.0948218	2.52	0.012	.0532351	.4249297
_predict 2	.0001225	.0447117	0.00	0.998	-.0875108	.0877558
_predict 3	-.2392049	.0660464	-3.62	0.000	-.3686535	-.1097563
TECHNOLOGY_ADOPTION						
_predict 1	.0025408	.0963263	0.03	0.979	-.1862552	.1913369
_predict 2	.0002802	.1022768	0.00	0.998	-.2001787	.2007392
_predict 3	-.0028211	.0276592	-0.10	0.919	-.057032	.0513899

APPENDIX F: TRANSLATED QUESTIONNAIRE

MBUDZISO DZA VHALIMI

Phindulo dzavho khaa mbudziso dzi tevhelaho a si dzine dza do phadalawadza, dzi do shumiswa nga mugudi na gudedzi ya Univesity ya Kwa-Zulu Natal fhedzi.

Duvha:	Masipala/ siela:	Dzina la muvhudzisi:

Tshitenwa tsha A

1. Minwaha ya muvhudziswa

(0) ≤25<	(1) 25- 35	(2) 35 - 45	(3) 45 - 55	(4) 55 - 65	(5) 66

2. Mbeu

(0) Mufumakadzi	(1) Mmuna

3. Mbingano

(0) Ha ngo vhingiwa	(1) Vho vhingiwa	(3) Fhandekana	(4) Tshilikadzi

4. Ngudo ya pfuna ya nnthesa?

Avha ngo dzhena tshiloko (0)	Puramiri (1)	Sekondari (2)	Teshari (3)

5. vha vhangana hayani

Nomboro

Tshitenwa tsha B

1. Vha na egere ngana kha tsimu yavho

(0) fhasi ha 1	(1) 1-5

2. Vha na minwha mingana kha vhulimisi

(0) 10	(1) 10 - 15	(2) 25- 35	(3)35 - 45	(4) 45 - 55	(5) 55 - 65	(6) 66

Production Zwibveledzwa	Weekly visit Nga vhege	Monthly Nga nwedzi	Seasonally Nga khalanwaha	Annually Nga nwaha
	Min (R) Max(R)	**Min (R) Max(R)**	**Min (R) Max(R)**	**Min (R) Max(R)**
Z wilinwa				
Zwifuwo				

c. Vhubuli vhuswa nga ha tshi imiswa tshiswa nga mulimisi

Kha vha sumbedze uri vha tendelana na zwitevhelaho u swika gai ?	**Kha vha sumbedze uri vha tendelana na zwitevhelaho u swika gai ?** **Kha vha khoudu dzo sumbedwaho nga fhasi**
1. Pholisi ya masheleni	
Mutengo u sa shanduki	
Mutengo u no farea kana u badelisana na vhanwe	
Mbadelo ya mafheloni ha khalanwaha I fanela u vha hone	
2. Kwaliti ya mulimisi	
Mulimisi u tea uvha o pfumbudzwa nahone a ene makone	
Mulimisi u tea u vha wa u wanalea na kha vhupo ha mahayani	
Thuso ya mulimisi I tea u elana na ndimi ya khalanwaha yeneyo	
Thuso kha I thuwelane na khaedu	
Thuso ya mulimisi I tea u shumisana na thodea dza mulimi	
Vhalimisi vha tea u lwisa na u dzhenelela hu sin a thodea	
U lwa na u tsela fhasi ha tshumelo I nekedzwaho nga vhalimisi	