Title

AWARENESS AND ADOPTION OF AGRICULTURAL
ECOMMERCE APPLICATIONS BY SMALLHOLDER
FARMERS IN BUSHBUCKRIDGE LOCAL MUNICIPALITY,
MPUMALANGA PROVINCE.

**A dissertation submitted in full fulfilment of the requirements
for the degree of Master's in Agriculture at Cape Peninsula
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**A research dissertation submitted by
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DECLARATION

I, Progress Lefsifi, declare that this dissertation for the Master of Agriculture submitted by me to the Department of Agriculture in the Faculty of Applied Science at Cape Peninsula University of Technology has not been previously submitted for any degree at Cape Peninsula University of Technology or any other institution. I confirm that this is my work, and all reference material has been duly acknowledged.

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ABSTRACT

Farming practices in the rural areas are often indeed by limited access to markets, low digital literacy and infrastructure, which have an effect on the productivity and profitability for smallholder farmers. The study's aim was to address these issue through assessing the awareness and adoption of ecomerce applications tailored for agricultural practices by smallholder farmers in Bushbuckridge Local Municipality. The study applied a mixed method approach, where qualitative and quantitative data is collected from 114 smallholder farmers. The data collected comprises of socioeconomic characteristic factors like gender, education, digital literacy, and an evaluation was conducted to determine factors that affect their uptake on agricultural based ecommerce apps.

The results of the study showed a high level of awareness regarding agricultural ecommerce applications, even so, there remains persistent obstacles. Lack of digital literacy, insufficient resources to invest in new technologies and limited access to extension services are the contributing factors that hinder adoption wiliness. However, the study reveals that there is a potential for ecommerce adoption by farmers as most of them are young and spend more time interacting with the internet.

The study's finding reveal the importance of digital technologies for agricultural extension services and recomment policies that prioritize gender inclusiveness, creating mentorship programs that are tailored for these farmers and diversifying income. Therefore, is it crucial to improve digital literacy by equipping smallholder farmers with with skills that play a role in them adopting ecommerce applications to theirr farming activities, this will enhace sustainability, productivity and a wide market reach.

LIST OF ACRONYMS

eCommerce - Electronic Commerce

FAO - Food and Agriculture Organization

GSMA - Global System for Mobile Communications Association

H0 - Null Hypothesis

H1 - Alternative Hypothesis

ICT - Information and Communication Technology

IDT - Innovation Diffusion Theory

NGO - Non-Governmental Organization

SMEs - Small and Medium-sized Enterprises

SPSS - Statistical Package for the Social Sciences

TAM - Technology Acceptance Model

TOE - Technology-Organization-Environment

TPB - Theory of Planned Behaviour

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CHAPTER 1: INTRODUCTION

1.1 Purpose of the study

The main aim of this study is to examine, understand and address the adoption of South African agricultural ecommerce apps like Khula, AgriKool and ThriveAgric among others, by smallholder farmers in Bushbuckridge Local Municipality of Mpumalanga Province, South Africa. This aids in assessing farmers' awareness of such tools. The study further examines challenges faced by farmers with regards to the willingness to adopt ecommerce apps, like the lack of digital literacy and usability, etc. This plays a vital role as it helps policymakers and stakeholders to come up with tailored initiatives, interventions and support for smallholder farmers. This study also looks into how various demographic attributes like gender, age, education levels, income, etc help shape adoption. This research serves as an important tool for formulating actionable steps to help strengthen access to the market and improve digital literacy skills among smallholder farmers to help foster successful adoption. This will therefore contribute significantly to the livelihoods smallholder farmers.

1.2 Context of the study

Agriculture contributes significantly to the growth of the economy and food security in the world, with an estimated global labour force of 27%, and it contributes significantly to the Gross Domestic Product (GDP) in many emerging markets (FAO, 2021). On the other note, smallholder farmers comprisea higher share of food production worldwide, with an estimate of over 80% consisting of backyard or family-led farming and majority of the world's population's feed on that (Lambrecht et al., 2020; Hung & Douglas, 2021). Despite their contribution, most smallhoder farmer are encourtedred with challenges such as limited access to markets, low technology adoption rates and other factors, which therefore affect their productivity and resilience.

In developing countries like African countries, agriculture is sought to be the main source of economic stability and poverty alleviation. Smallhoder farmer in these countris comprises of about 60% to 70%, however, their reliance is most on rain-fed

agriculture and are faced with challenges such as the use of farming techniques that no longer suits their productivity and profitabily (World Bank, 2020).

South Africa, which is often considered a relatively industrialized country, is still affected by these challenges, ecpesially within its rural areas. Rural areas in provinces like Mpumalange are faced with challenges like limited access to markets, high input costs, inconsisted input supplies and supply chains that are fragmented. These factors restrict their competitive in the markets, both dometic and internationally (South African Cities Network, 2015).

Over the years, ecommerce platforms have been making their ways with a promise to offer solutions to these challenges through transaction costs reduction, market expansion and access to market information in real time. On a global scale, agricultural based ecommerce applications have proven to have a potential in streamlining sales, procuring of farming inputs and connecting farmers with not only customers but also suppliers (Abeleira et al., 2019). Moreover, the increase in ownership of smartphones in african countries is predicted to reach 615 million by 2025 (GSMA, 2020). This shows a strong foundation for adopting such digital tools. However, there are concerns with these tools, like the lack of digital literacy, trust on online transactions and lack of proper thechnological infractravtures become a challenge for adoption, mainly among smallholder farmers with limited finances resources are the lack of formal education.

Rural communtinties in like Bushbuckridge Local Municipality showcases these broader trends. Althought the level of smartphone and internet use contibues to grow, the he actual adoption of agricultural ecommerce applications remains relatively low (Simelane et al., 2019). This gap indicates that smallhoder farmers are either unaware of these solutions or they view them as complex tools, which are risky or pricey to put into use for their farming practices. Smallholder farmers who have embrased these ecommerce applications have seen benefits like high income, market access stability and improved productivity (Kamilaris et al., 2017). These results are align with the broader shift in knowledge-intensive agriculture, wherein digital platforms can facilitate learning continuously through collaboration, and data-driven decision-making.

1.3   Problem statement

In Bushbuckridge Local Municipality, Mpumalanga Province of South Africa, smallholder farmers have shown to play an important role in the production of agricultural commodities and food security. However, the their adoption rate on agricultural ecommerce application which have been developed to improved their market access and streamline their farming their practices is relatively low. Despite the development of agricultural ecommerce platforms amined to support activities soch as online input sourcing, market access, most farmers are either not aware of these digital solutions or see them as complicated to use. This issue occurs in a context where digital tools are becoming more critical for enhancing productivity, income, and resilience. Moreover, there is limited research that focuses on addressing the awareness of these digital tools by smallholder farmers in Bushbuckridge and the actual adoption of them, this further obscure the potential to effectively enhance adoption of these tools. This gap in awareness and adoption may continuously hinder growth in farming within the rural area, if the issue is left unattended. It is therefore important to investigate factors that affect smallholder farmers' willingness to adopt agricultural ecommerce apps, as it is will not only help relevant organisations to design tailored programs, but also serves as a important tool for closing the gap between individuals who are aware of innovations and still choosing not to adopt.

1.4   Research Objectives and Questions

1.4.1   The study's objectives are to:

- Determine the Socio-economic characteristics of smallholder farmers
- Assess the awareness of agricultural e-commerce applications by farmers.
- Explore the relationship between the awareness of agricultural e-commerce apps by smallholder farmers in Bushbuckridge Local Municipality and their willingness to adopt.
- Investigate factors that affect farmers' willingness to adopt agricultural ecommerce apps.

1.4.2 The questions of the study are as follows:

- What are the Socio-economic characteristics of smallholder farmers
- Are farmers in Bushbuckridge local Municipality aware of agricultural ecommerce apps?
- What is the relationship between the awareness of agricultural ecommerce apps by smallholder farmers in Bushbuckridge Local Municipality and their willingness to adopt
- What are the factors that affect farmers' willingness to adopt agricultural ecommerce apps?

1.5 Justification of the study

The main aim of this study was to gather important information that can help with the process of successfully adopting agricultural ecommerce apps by smallholder farmers, which will help these farmers have more access to the market for both selling their end produce and buying inputs, as well as an opportunity to boost their profit. Moreover, the study will serve as an additional insight or will strengthen the already existing information about technological advancements in agriculture. In this way, the findings of this study can be utilised as a guide to come up with new policies and for organisation to design tailored initiatives to help foster adoption of the apps among smallholder farmers. There is a likelihood of new evidence-based intervention to emerge; this will enable efficiency in the allocation of resources and programmes that are designed to cater for digital literacy. The outcome of this study will also serve as a contribution to discussions regarding inclusive growth, especially in countries that are still developing, by placing an emphasis on the potential benefit that e-commerce tools have on farms in rural areas. These insights are crucial for enhancing sustainability in agriculture, thereby fostering safer and more diverse marketing channels to help grow the agricultural economy in rural areas.

1.6 Delimitations of the study

The study mainly focused on vegetable farmers and may not apply to smallholder farmers whose produce are not vegetables. This is because the agricultural e-commerce applications deal mainly with vegetable produce.

1.7   Definition of terms

1.7.1   Adoption of technology

Technology adoption refersto how individuals, organisations, and others integrate technological innovations into their existing activities. It comprises the awareness, comprehension, acceptance and effective use of technology to achieve a specific outcome (Rogers, 2003). This involves the acquisition of necessary infrastructure, like hardware or software, and adopting processes to incorporate technology in an effective manner. Success in technology adoption often comes from improved productivity, efficiency and profitability, therefore leading to growth (Brynjolfsson & McAfee, 2014).

1.7.2   agricultural e-commerce Applications

Agricultural ecommerce applications are computer software programmes designed to perform tasks like trading of goods or services on the internet. These applications are designed to be used on different tools like computers, smartphones, tablets, etc. They are mainly designed to assist farmers in accessing markets in the comfort of their own home, and examples of these tools are Khula, Agrikool, Burro and ThriveAgric (Silva, 2017).

1.7.3   Farmers' Awareness

According to Smidt, H.J. (2021), farmers' awareness is the level of knowledge, comprehension, and recognition among farmers on things that pertains their farming practices, these include things like the dynamics of the market, climate and environmental factors, challenges and opportunities among other factors that affect their farming practices. It also includes their view on modern farming approaches, tools thar are innovative and ways to sustain practices in agriculture. This awareness extends to their understanding of trends in market , pricing mechanisms and opportunities in adding value to their ventures (FAO, 2020; Qureshi & Azeem, 2017).

1.7.4 E-Commerce

E-commerce, stands for electronic commerce, which is referred to the exchange of goods and services on the internet. It includes a variety of transactions that are performed like retailing, payments, marketing, and the exchange of data between businesses, consumers, and agencies. E-commerce focuses on eliminating barriers in a geographical sense, therefore allowing businesses to reach customers in various location, wordwide. It has revolutionized the way businesses work and how consumers access products as well as services, therefore offering convenience, efficiency and accessibility (Laudon & Traver, 2020).

1.8 Assumptions

- The study's assumption is that smallholder farmers in Mpumalanga Province have access to smartphones, tablets or computers to access and use agricultural e-commerce apps.
- The study assumes that smallholder farmers have the necessary skills to operate these platforms and are familiar with how they function and how they can benefit from them.
- The study assumes that smallholder farmers have the means to afford paid agricultural e-commerce applications and internet connectivity

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A literature review is defined as a component of academic writing that showcases knowledge and understanding of an academic written work on a specific study or topic. It is used to critically analyse research studies based on a topic of interest (University of Edinburgh, 2022). In this study, the literature to be reviewed is empirical as well as theoretical literature. An empirical literature review reviews research articles or studies presenting findings and conclusions based on direct observations, thus providing empirical evidence to support formulated hypotheses (Johnson et al., 2015). Whereas Theoretical literature review focuses on reviewing works that explore and develop conceptual and theoretical frameworks or models without direct observations, and it is often derived from existing literature and theories (Thompson & Williams, 2018). The subsections below present and interrogates both theoretical and empirical literature pertaining to the current study.

2.2 Theories of Technology Adoption

Mouza (2018) defines 'theory' as a fact or a collection of facts that provide clarity to better understand how the world around us functions and often elucidate the connections between different phenomena. These theories provide different perspectives and factors when it comes to the adoption of new technologies. They can be applied in real-world scenarios to assess the effectiveness of new technology innovations. Along with that, they also serve as guidance for technology innovators to understand what actually matters to individuals when it comes to adopting their products. In this way, innovations can be tailored for specific needs of the potential users.

2.2.1 Innovation Diffusion Theory (IDT)

This theory was developed in 1962 by Everett Rogers to help understand why, how and what rate do news about new advancements spread. To support this theory, a study to investigate how one's socials can affect how a new technology is adopted

was conducted by Mahajan et al. (1990). The findings of their study revealed that recommendations from social networks is a important factor for individual's decision to adopt new technologies. Another study that was conducted by Bikhchandani et al. (1992) revealed that new innovative tools tend to spread through social networks; this suggests that the adoption of new technologies is highly impacted by an individual's peers or social network. When looking at the context of this study, this theory is applicable, as farmers often socialise with other farmers; in this way, they learn from each other about their practices, which can be beneficial in many ways. if a farmers sees that another farmer is doing well, they will likely ask for advice from them in order to achieve similar results, so in a case where they see that they are using ecommerce apps, they will be likely to give them a try.

2.2.2 Technology-Organization-Environment (TOE) Framework

This theoretical framework was developed and published in 1990 by Mitchel Fleischer and Louis G. Tornatzky. Its main focus is to provide an explanation as to how the process of adoption, as well as the use of new technology innovations, is influenced by varying factors, such as the technology itself, what it does and what it comprises, along with that in the context of the organisation in which a technology is used and other external factors accompanied by an organisation's operations. Over the years, this framework has been implemented worldwide and is covered in many studies.

An example of a study was one by Zhu et al. (2006), which investigated how organisational factors impact the technology adoption process across different countries. Their study revealed that when organisations have access to the right resources and when decision-makers in organisations are always looking for new technologies to improve their organisations, chances are they will be keen to adopt the right technologies for their company. Another study that applied this theory focused on the adoption of cloud computing in small and medium enterprises (SMEs). This study revealed that decision-makers within organizations who supported the idea of trying out new technologies, and the technological factor they possessed mattered when it came to the adoption of cloud computing tools. The study suggested that it was important that factors pertaining to organisations be checked to ensure that they align well with technologies they want to start implementing. These findings suggest that depending on how farmers in the study area operate within their farming practices,

the likelihood of them trying out agricultural ecommerce apps depends on whether they are on the look for ways to improve how they operate in their ventures or whether these ecommerce apps align with their practices.

2.2.3 Uncertainty Reduction Theory

In 1975, Richard Calabrese and Charles Berger developed the uncertainty reduction theory. This theory basically focuses on explaining how individuals behave under certain circumstances. For technology adoption purposes, this theory entails how individuals' perspectives about technologies vary based on what they know about them. For instance, if people are not sure how a certain tool works or whether it can benefit them, the likelihood of them trying it out is lower compared to when they know more about it and have seen it in action. In support of this theory, McKnight et al. (2002) conducted a study to determine how developing and validating measures of trust for ecommerce impact adoption. Their study revealed that individuals are willing to try out ecommerce when it is legit, thus increasing the chances of adoption. Moreover, their results showed that in order to ensure that individuals become certain about using the platforms, measures like improving the service's quality and ensuring that these platforms are secure are needed, and individuals will likely try them out because then, they are certain that they will get a good quality product and that their security is not compromised. This theory is applicable to this study; for instance, if smallholder farmers in the study area can see that these ecommerce apps are actually legit and using them would not result in them risking their businesses or their names in any form, they are likely to adopt them. Another thing that may benefit the adoption process in the study area is if they see that there are success stories in areas similar to theirs. Moreover, if they can see that the inputs they are buying from these platforms matches their preferred quality and there are actually ways to make payment which they are familiar with, they will be keen to try (Johnson & Brown, 2020).

2.2.4 Technology Acceptance Model (TAM)

The model was developed in 1989 by Fred Davis; it focuses on understanding how users come to accept and use new technology. In the context of this study, developing applications that have friendly User Interfaces (UIs) and ensuring localisation of languages aid in enhancing the perceived ease of use for eCommerce apps.

Additionally, it is imperative to prove the usefulness of these apps, like market access, as it plays a big role in enhancing their value, therefore driving the acceptance rates to a higher force (Smith et al., 2021). Venkatesh and Davis (2000) investigated factors that affect users' perceptions of technology usefulness and ease of use. It the study, it was revealed that perceived usefulness is dependent on factors like the task a specific tool perform and results they achieved, whias perceived ease of use was derived from factors like the complexity of the system and user experience. Another research conducted by Legris et al. (2003), The model was utilised to examine the acceptance of online banking services by users. It was found that perceived usefulness and perceived ease of use have significant impact on users' plans to adopt banking apps. In Bushbuckridge, designing intuitive and user-friendly interfaces for ecommerce applications and demonstrating their usefulness in improving market access and financial services can enhance farmers' acceptance and adoption rates.

2.2.5 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) states that attitudes, subjective norms, and perceived behavioural control influence behavioural intentions and, after, actual behaviour (Icek Ajzen, 1985). For Bushbuckridge farmers, positive testimonials and endorsements from respected local figures (subjective norms) significantly influence attitudes. It is very important to address the gaps in digital literacy as well as provide training sessions, as it empowers farmers to adopt ecommerce apps (Ngwenya et al., 2019). Encouraging positive attitudes and increasing perceived control positively affects adoption intentions.

In support of TPB, research by Ajzen (1991) examined the predictive power of attitudes, subjective norms, and perceived behavioural control on individuals' intentions to adopt new technologies. The study found that attitudes towards technology, social influences, and perceived behavioural control significantly influenced adoption intentions, which in turn predicted actual adoption behaviour. A similar study conducted by Taylor and Todd (1995) used this theory to investigate the intensions of consumers in using IT products. The showed that norms that are subjective and perceived behavioural control have an impact in individuals' decisions to adopt. For this study areas, the providence of training and addressing gaps in digital

literacy can aid in empowering farmers' confidence in engaging with these apps, therefore driving adoption willingness to a higher note.

2.2.6 Resource-Based Theory

Resource-based theory stresses how important resources like knowledge and technology are for getting an edge over competitors (Penrose, 1959). It is important to provide smartphones, make it easier to connect to the internet, and hold digital literacy workshops in Bushbuckridge (Ngwenya et al., 2019). Government programs that give these resources focus on working together, which makes eCommerce apps available to farmers who don't have a lot of money. Making resources more available helps close the digital divide and encourages fair adoption.

Barney (1991) investigated the role of resources in an organisation's ability to obtain a competitive advantage. The research indicates that both fixed and non-fixed resources play a significant role in shaping an organization's competitive position. A Similar study investigated how technological resources are managed, it was revealed that capabilities of a technological tool can significantly improve the competitiveness of an organisation. In relation to this research, if farmers have access to smartphones and the internet and are digitally literate, they are likely to gain a competitive advantage in the market of agriculture.

2.3 The Importance of ecommerce applications in Agriculture

Digital technologies are always evolving, and the agricultural sector is experiencing a change in the use of these technologies. Ecommerce platforms like Khula, Agricool, and ThriveAgric have been developed and serve as important aids in agricultural transformation. They enable farmers to increase their income with a wide market reach. These apps address marketing and input acquisition issues faced by smallholder farmers, and they help contribute to sustainable agriculture. They provide farmers with ease of access to agricultural inputs as well as marketing opportunities for their end product, and they play an important role in enhancing efficiency, profitability, and sustainability across farming practices. The following subsections provide an overview of some of the important roles of agricultural e-commerce platforms.

2.3.1 Marketing of agricultural Products

With agricultural e-commerce applications, farmers can trade their produce online, this is known as digital marketing. A study conducted by Rameshkumar, (2022) found that Digital Marketing is essential to farmers as it helps them in reaching out to multiple buyers and obtain competitive prices for their products and many agricultural startups could benefit from this, as it empowers them. Similarly, a study conducted by Peter and Latha, (2021) revealed that using gricultural ecommerce applications in agricultural marketing is not only beneficial to farmers for to sell their products but it also aids in cutting cost as they are on the lower side in comparison to traditional marketing.

2.3.2 Income generation

Through online presence, farmers may be exposed to a greater market price and transparency, facilitating the attainment of fairer prices compared to conventional markets, as highlighted by GSMA in 2019. This is achieved through the minimization of intermediaries with the market chain and optimizing the process of distribution to increase efficiency. This shift improved profitability in farming, and led to an improved economic outcome within the sector. A study by Xiaokang Li et al, (2021) found that farmers who took an action by adopting these apps saw a significant increase in their income when compared to those who did not. This resulted from higher sales rates resulting from the expanded exposure to a larger pool of consumers facilitated by their online presence.

2.3.3 Waste Reduction

The Food and Agriculture Organisation (FAO) identifies food waste occurring across various stages of value chain, starting from handling, transportation, storage, and more (FAO, 2019). In contrast, ecommerce in agriculture is proved to reduce food waste, specially in the regard of post-harvest as it optimizing market efficiency. Farmers tend to lose about 3% of their produce with traditional marketing. However, the use on online tools help farmers in accessing more customers, not only that but they can also negotiate better prices as compared to what their middlemen usually offer (FAO, 2019). These digital avenues enable direct sales, thereby allowing farmers

to sell their products in a brief period, which then reduces the risk of post-harvest waste.

2.4. Socio-economic characteristics of smallholder farmers

The demographic factor of smallholder farmers withing countries that are still developing comprises of a range of attributes that define their social and economic status within the agricultural sector. These characteristics comprises of things like education, income, age, gender, size of household, and access to resources. Having a comprehension of these fator is crucial for obtaining information about the challenges and opportunities encountered by smallholder farmer in the study area, as they these can help make an impact on their farming practice, (Zondi, Ngidi, Ojo & Hlatshwayo, 2022). Outlined below, are they key aspects of socio-economic profile of smallholder farmers in developing countries like South Africa.:

2.4.1. Market Challenges and Price Volatility

Smallholder farmers sometimes have a hard time finding markets that they can trust and getting fair prices for their goods. One of the biggest problems is that it's hard to get important market information (Gupta, 2023). Farmers don't often receive real-time updates on market trends, changes in demand, or current prices, which makes it hard for them to know when and where to sell their crops. The situation worsens due to weak infrastructure within the market, mainly with transportation and storage facilities that are inadequate. Post-harvest losses arise due to poor storage, thereby resulting in reduced sales and transportation that is not efficient causes delay which affect the quality of produces that perishable.

2.4.2. Gender Dynamics

Gender constitue a hude role in in smallholder farming, with women actively taking part in farming practices (Asamu et al 2020). Their role mainly include doing activities like cultivation, livestock management and post-harvest processing. However, this gender inequality occurs in terms of access to resources, land tenure, and decision-making processes (Chagomoka et al., 2015). Women may have limited control over land as well as resources, which can affect their productivity and income. A

coorehension of these demographics is very important for developing interventions, policies, and technological solutions tailored to their specific needs.

2.4.3. Education

The level of education among smallholder farmer differs, along with the implication for their ability to adopt new tools and method or farmer (Foster & Rosenzweig, 2010). The higherthe level of education they possess they they are likely to achieve a high productivity in their farming practices as well as their gaining more profit (Duflo et al., 2018). Education enables smallhoder farmers to engage with markets, access information, and navigate through formal institutions (Foster & Rosenzweig, 2010).

2.4.4. Employment Status and Occupational Sector

Majority of smallhoder farmer in countries that are still developing rely on farmer as their primary source of income, whereas other may have some other sources like employment to help supplement their income (Haggblade et al., 2010). The occupational sector diversification is different, such that some farmers engaged in activities that do not pertain agriculture such as trading or wage labor (Reardon et al., 2019). Employment status significantly impacts household income, resilience to shocks, and the capacity to invest agriculture (Dorward et al., 2009).

2.4.5. Income

The level of income among smallholder farmer are relatively low and depend on seasons (Fafchamps & Shilpi, 2008). This insufficiency deter farmers' ability to inovet as well as adopt tools that can enhance their far,ing practices (Barrett, Reardon, & Webb, 2001). This also affects the diversity in dietary need as well as good security in their households (Jones et al., 2014).

2.4.6. Social Influence

The processes of making decision and accessing of resources by smallholder farmers is directly influenced by social networks and the dynamic of communities (Conley & Udry, 2010). When farmers have strong social ties, they are proned to receiving more knowledge from their peers or social networks (Bandiera & Rasul, 2006). However,

social norms and power dynamics may also contiues disparities, ecpecially on matters concerning gender and ethnicity (Quisumbing et al., 2015).

2.4.7. Farmer's Progressiveness

Framer's willingness and ability to adopt new method, tools or even market opportunities varies based on individuals (Foster & Rosenzweig, 2010). Farmers who are on the progressive side of things tend adopt innovations, seek information and invest in upgrading their skills and infrastructures at early stage (Duflo et al., 2018). This is directly influence by attributes liked education, extension services access and being exposed to individuals that are successful (Foster & Rosenzweig, 2010).

2.5. The Awareness of agricultural ecommerce Applications by Farmers

In light of the research focus, it is imperative to emphasise the importance of understanding smallholder farmers' awareness of agricultural e-commerce applications (Smith & Williams, 2022). This dimension outlines an understanding of awareness of agricultural e-commerce technologies among farmers in relation to their functions and benefits (Anderson, 2020). Such knowledge is important, since it proves to be the basis of willingness to adopt (Johnson & Brown, 2021).

2.5.1. Are smallholder farmers aware of agricultural ecommerce apps?

It is important to understand the awareness of agricultural ecommerce applications by smallholder farmers because this is beneficial in several ways. Awareness serves as a tool to help farmers understand the situations they are dealing with and ways they can apply solutions for them. Other benefits associated with awareness for farmers include increased profit. To explain this, farmers who are aware of things that may impact their business, like technologies or ways to access broader markets, are likely to take action by using the information to their advantage to maximise their profits. Other benefits of farmer awareness include making better decisions, access to adequate resources, improved farming practices, enhanced food security and empowerment among smallholder farmers.

The key aspects that matter when it comes to awareness are information about the market; when farmers know the market so well, they will have an idea of what to produce and how much. Market access can also help them diversify their produce and provide them the opportunity to export their produce to other places they may have never thought of. Technological advancement ensures that farmers understand how to use a specific technology to their benefit; when they know all this, they can improve their farming practices in many ways, like reducing costs and optimising yield and increasing efficiency, which positively impacts their profit.

Numerous studies have proved that awareness factors a lot. For example, in a study conducted by (Ngwenya et al., 2019) in the rural areas of South Africa to determine farmers's awareness of conservation agriculture, it was found that the lack of access to programmes tailored to educate farmers about certain tools and practices along with access to technology proved to be an issue as farmers were never awareness about practices that could enhance their practices. The study further indicated that initiatives that were already implemented to help farmers grow were not actually fit or did not cate to the needs of the farmers, thus making it difficult for farmers to be more aware. Agricultural extension officers have also reported that farmers who only rely on their usual farming practices and are not keen to try out new ways of farming were not really aware of a lot of things that could improve their methods of farming. They also noted that most farmers did not have access to proper technologies like smartphones and the internet, which could have been beneficial in increasing their level of awareness, thus affecting their chances of being aware.

Moreover, smallholder farmers' awareness differs based on their situation. To help address this problem, different methods should be implemented for different people, like more engagement between smallholder farmers and agricultural extension officers, access to necessary tools that will enhance awareness, and encouraging farmers to explore different methods of farming.

2.5.2. Smallholder farmers' awareness of agricultural ecommerce applications and their willingness to adopt

The correlation between the awareness of agricultural ecommerce applications by smallholder farmers and their willingness to adopt these apps serves as an important

tool for making sure that they are used successfully once adopted and that they actually achieve greater rewards. This subsection outlines how awareness can impact smallholder farmers' willingness to adopt by looking at factors like what and how much they know, the challenges faced, the benefits associated, and how easy they are to use, among others.

2.5.1.2. Knowledge

Knowledge is key to awareness and willingness to adopt. So if farmers get to know that there are tools or technologies that can be used to enhance their farming practices, like providing them with access to the market and easy acquisition of inputs, they may be inclined to want to know more about these tools, like how they work, what benefits they can get and if there are other people who have adopted them, therefore looking into whether they had success from them or not. In this way, they will be more informed and make better decisions regarding adoption (Abiri et al., 2023). Moreover, knowledge can be one thing, but without action it doesn't do much; therefore, in other cases, farmers may know of tools that they can use, but if they don't do more research on them, they become useless, which is where intervention by organisations, governments and extension officers comes in. Through the provision of training programmes that provide more information about tools that farmers can introduce to their farms, farmers' knowledge can be greatly increased so that they become more confident to actually try them on their farms.

2.5.1.2. Access to the right Infrastructure

Infrastructures like technologies that allow you to perform a certain task or access certain tools and information are important for fostering adoption. These infrastructures could be cellphones, tablets, computers and the internet, which can be used to access necessary tools. So, if farmers do not have proper smartphones or struggle with internet access, it means that they may not be aware of technologies that may help enhance their farm's profit. Another thing could be that farmers may have smartphones but live in areas where internet access is a struggle; therefore, they won't be exposed to online things which may enable them to be aware of ecommerce applications (Mabuza & Dlamini, 2021). This has actually been seen in many studies

that focused on rural areas. Apart from that, finances do factor a lot in both ways, one being that farmers may not have enough money to afford smartphones and buy internet data, or that some of the apps require subscriptions in order to be used; farmers may not be able to afford such, which therefore leads to lower chances of awareness, which often influences the willingness to adopt. So, making sure that these problems are looked at and solutions are provided can actually make a difference, thereby increasing the rate of adoption. not only that but farmers may see success from it through improved farming activities, like wider access to the market, meaning more produce to be sold.

2.5.1.3. Digital literacy skills and training programmes

Digital literacy skills factor a lot when it comes to the awareness and adoption of new technologies, and so do training programmes tailored to equip smallholder farmers with the skills (Johnson & Brown, 2020). Farmers who may not know how to use smartphones, laptops or tablets may not have any idea about apps, but through these tools farmers can actually search for tools that can improve their overall profit or any other activity on the farm. Not only that, but they can also get tutorials on how they work. But without knowing all this, the likelihood of awareness is then low. On the other hand, farmers may still have smartphones but still not know how to use them beyond making phone calls. Moreover, training programmes are there, but they may actually not be helpful for other farmers,, as they may possess different levels of digital literacy skills. So tailoring them based on what these smallholder farmers know will be useful, therefore increasing the chances of awareness, which will help foster adoption of these ecommerce apps.

2.5.1.4. Perceived Utility and Relevance

If a tool is proved to be useful and relevant, individuals will be keen to try it out. For example. Smith & Williams (2022) talk about how smallholder farmers are likely to adopt ecommerce applications when they are aware that they serve the purpose of accessing the market as well as providing inputs, but this can happen only if they see that these tools are useful for their case. An example of this topic is seen in a study that was conducted by Osei-Kyei and Chan (2018), where they saw that many

smallholder farmers were facing problems that affected their farming activities so badly; these problems were the weather patterns that are constantly changing and pest and disease outbreaks. Seeing that these farmers were really struggling, they evaluated apps that can be used to mitigate these risks, and their findings revealed that farmers were actually more inclined to give these tools a shot because they saw that they could greatly benefit from them. So, since farmers in the study area do struggle with being consistent in their produce to do lack of reliable markets,they will likely take on the ecommerce solutions because it provides them with marketing opportunities. Not only that but they can also but input from the comfort of their own home, which in most cases may be a cheaper option as there's a wide range of suppliers to choose from.

2.5.1.5. Trust and Reliability

Trust building plays a significant role in fostering adoption of agricultural ecommerce applications among smallholder farmers. Farmers in developing countries were found to be more inclined to adopt innovative tools or applications if they had trust in them; this trust came in different forms. When individuals see their peers using a specific tool that may actually benefit them as well, they are likely to try it out. Moreover, in some cases the willingness to adopt these tools comes from the education they receive from their role model, reputable organisations or agricultural extension officers (Johnson & Brown, 2021). One other way to build trust among farmers is to use successful stories or testimonies from other farmers . In this case they actually get to know that the tools do work. To foster more of this adoption, different organisations can collaborate to deliver the news to farmers. For instance, the likelihood that a developer can gain trust from farmers on their own is relatively low as compared to collaboration with organisations or people that these individuals trust. in this way, the adoption of new innovative technologies will be enhanced (Johnson & Brown, 2021).

2.5.1.6. Affordability and Cost-effectiveness

Smallholder farmers in rural areas are willing to adopt innovative technologies provided that they are either free to use or are affordable. Therefore, if a tool that can benefit farmers is expensive, the levels of adoption will likely be low. This evidence has been shown by a study conducted by Smith & Williams (2022), where farmers in

many developing countries only invest in tools when they have the means to afford them. In relation to this study, most of the identified applications are affordable or free to use. This therefore indicates a positive outcome, as more farmers will be willing to adopt. Other initiatives that could be taken to ensure the adoption include subsidies or receiving assistance from the government and non-governmental organisations.

2.7. Conclusion of literature review

A lot of studies have shown that smallholder farmers in developing countries have different demographic attributes that require different needs. This suggests that challenges faced by one group of smallholder farmers won't be the same as those faced by another. The challenges that these smallholder farmers encounter are dependent on their socioeconomic factors, which include limited access to resources like technology, finances, extension services and market information. When formulating new technologies, it's important to make sure that they are tailored to address the specific needs of these smallholder farmers. Moreover, there is a strong correlation between the socioeconomic characteristics of smallholder farmers across various areas of the world, and their knowledge about agricultural ecommerce apps or any other innovative tool is dependent on their demographic attributes, such as level of education and initiatives that take place in their communities.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

Mimamsa and Nitin (2019) have defined research methodology as a systematic and theoretical analysis of methods used in a study. In other words, it consists of analysing theories using different approaches and principles in line with the field of study. It is a scientific way of conducting research/study and a way in which research problems are systematically solved by adopting different steps logically (Eyisi, 2016). The following sections will provide an in-depth analysis of the analytical procedures to be adopted in this study to achieve research objectives.

3.2. Study Area

Bushbuckridge Local Municipality is in the northeastern part of Mpumalanga Province, South Africa, with coordinates that are approximately between 24°50' S and 31°10' E. This area covers about 10,250 square kilometres and as per the latest census data, it has a population of over half a million of residents (Stats SA, n.d.). It is mainly characterized by rural, comprising of high levels of poverty and unemployment, which has led to majority of households relying on small-scale farming as a key livelihood strategy.

Climate-wise, Bushbuckridge has a subtropical climate with warm to hot summers and mild winters; these conditions are generally favourable for farming vegetables. It is mostly suitable for growing produce, such as tomatoes, spinach, and cabbage, among others (Department of Agriculture, Forestry, and Fisheries, 2019). This produce helps the economy and food security in the area. However, farmers are faced with various hindrances, such as limited access to formal markets as well as modern technologies; this therefore affects their income.

3.3. Research Approach

Qualitative research approach was applied in this study and it proved to be effective. This approached was helpful for making sure that the data collected was well structured, which allowed for a smooth analysis. It it also reliable, making sure that the

conclusions drawn from the study are based on data that can be verified and address the research problem.

3.4. Research Design

A study by Lelissa (2018) defines research design as the process of collecting, analysing, interpreting, and reporting data for research studies. Research design is also referred to as a way of integrating various aspects of a research study to address research problems of that study, and it includes things like collecting, measuring and analysing data (Harish, 2021).

The main aim of this study is to assess smallholder farmers' awareness and willingness to adopt agricultural e-commerce applications; therefore, choosing a cross-sectional research design is suitable for that

This approach helps with gathering data that is qualitative and quantitative from different farmers; this help paints a clear picture of awareness and willingness to adopt agricultural e-commerce applications within the study area. Another thing is that this method ensures that the method is cost-effective as well as time effective, therefore making it easier to explore the factors that influence smallholder farmers' willingness to adopt e-commerce applications in Bushbuckridge Local Municipality, Mpumalanga province, South Africa.

3.5. Population and sample

The study population comprises all vegetable farmers within the Bushbuckridge Local Municipality, Mpumalanga Province. The Bushbuckridge Local Municipality Agricultural Office says that there are about 1,500 vegetable farmers in this area. This estimate is derived from local agricultural surveys and records from the municipality. Banerjee and Chaudhury (2010) say that the population is the whole group of people that researchers want to study.

3.5.1. Sampling Method and Sample Size

To ascertain the sample size, the researcher employed the Yamane formula for sample size calculation, customised to the projected population size:

$$n = \frac{N}{1 + N(e)^2}$$

where:

- n = sample size

- N = population size

- E = margin of error (0.05 for a 95% confidence level)

Therefore:

$$n = \frac{1500}{1 + 1500(0.05)^2}$$

$$n = 316$$

A sample size of 114 participants was chosen for this study due to limitations like resources and timing. This numerical value ensured a balance between the feasibility of the study and the statistical power, thereby giving a clear picture of the population in the study area.

A purposive sampling procedure was used to uncover the exact number of respondents. Given that the researcher was provided access to a database containing registered vegetable farmers in the study area, which was about 1500, it became easy to identify farmers who were good participate in this study, the focus most comprised of those who were actively producing at the time of the study. This made it easy for the researcher to gather insights from relevant sources/farmers to fulfil the study's objectives.

3.6. The research instrument

Data for this study was collected using a structured questionnaire, various interview styles like face to face, telephonic and through the use of online platforms were implemented. This was to ensure that farmers were interviewed at their convenience. Using various methods to collect data allowed the researcher to gather a wide range

of insights from the targeted population. The questionnaire will consist of two sections and will be accompanied by an approved letter which will serve as a motivation for farmers to participate in the study and state the rationale toward the study being conducted. The sections of data to be collected will be as follows:

Section A will answer questions based on the following objective: To identify and describe the socio-economic characteristics of small holder farmers in Mpumalanga. Respondents will be asked to provide the socio-economic characteristics, as depicted in the questionnaire in the appendix page.

Section B: Questions under Section B are developed to address the following research objectives:

- To determine the awareness of agricultural ecommerce Application by Smallholder farmers.
- To determine the relationship between the awareness of agricultural ecommerce applications by farmers and their willingness towards adopting them.
- To determine the factors that influence farmer's willingness towards the adoption of agricultural ecommerce applications.

A questionnaire is attached on the appendix page and has a detailed list of all questions that seeks to answer the research objectives stated above.

3.7.   Data collection

Kabir and Curtin (2016) define data collection as a process of gathering information of interest, in an established systematic way that allows a researcher to answer their research questions, hypotheses, and examine outcomes of their study. It is also termed as a procedure by which accurate data is collected, measured, and analysed from different of appropriate sources to answer research problems, questions and forecast trends and probabilities (Simplilearn, 2023). There are various methods used for collecting data, which are known as primary data collection and secondary data collection. Simplilearn (2023) further explains Primary data collection as a procedure in which data is collected from original sources or directly from participant. This type of data collection enables researchers to get access to firsthand information that

specifically fits their research objectives. The data is collected through various methods, one of which is Questionnaires or Surveys, where a researcher's structure questionnaires to collect data from participants. In this case, it can be done in person, over the phone, or on the internet.

A structured questionnaire was used to collect data from 114 smallholder farmers in Bushbuckridge Local Municipality. The questionnaire asked about their demographics, farming practices, technology use, and what factors affected their awareness of and use of e-commerce.

3.8. Data analysis and interpretation

Karin (2023) states that data analysis as a process of assess data that is raw with the aim of making inferences regarding that information. It is mainly aimed at converting the available data that is cluttered into a format that can be easily understood, is more legible and conclusive, and aids in supporting the mechanism of making decisions (Bhatia, 2017). On the other hand, data interpretations is known a as a process of applying statistical methods to assess data and draw conclusions from the calculations. It helps researchers with categorising, manipulating, along with summarising information to account to the research questions, hypotheses, or objectives at hand (Calzon, 2023). The table below provides and overview of the objectives, data and analytical methods used in this study.

Table 3.1 An outline of objectives, data and analytical tools.

Objective	Data Required	Analytical Tool
Determine the Socio-economic characteristics of smallholder farmers	Gender, Age, Education, Access to extension services, Farming experience, Employment status, Marital status, Industry of work or study, annual income, access to smartphones, hours spent on the internet per week	Descriptive statistics
Determine the Socio-economic characteristics of smallholder farmers	Knowledge of platforms	Descriptive statistics
Explore the relationship between the awareness of agricultural e-	Awareness status (yes/no), adoption intention (yes/no)	Chi-square test

commerce applications and their willingness to adopt		
Assess the factors that influence farmer's willingness towards the adoption of agricultural ecommerce Applications	Socio-economic variables, technology access, user ability	Binary Logistic Regression

3.8.1. Chi-square test

The chi-square test plays an important role in checking if a relationship exists between variables (Agresti, 2018). The mathematical formula is a follows:

$$x^2 = \Sigma \frac{(O_i - E_i)^2}{E_i}$$

Where:

χ^2 = chi-square test

O_i = observed frequency

E_i = expected frequency

3.8.2. Binary Logistic Regression model

The Binary logistic regression model was developed in the 1960s and has continuously been improved, making it a widely used statistical tool for analysing outcomes that are binary in social science studies (Hosmer & Lemeshow, 2000). Its effectiveness lies in its ability to generate predictions ranging from 0 to 1 through the logistic function, making it particularly useful for evaluating binary decision-making processes, such as the adoption of technology (Cox, 1958; Greene, 2012). The model

was applied in this study to help to identify the factors that influence smallholder farmers' willingness to adopt agricultural e-commerce applications. There are a few key reasons why this model was chosen. Firstly, the dependent variable is binary, meaning that it simply shows whether a farmer is willing or not willing to adopt agricultural e-commerce apps (Shang, 2021). Secondly, this model makes it possible to see how different factors affect the likelihood of adoption, helping to understand what increases or decreases the chances of farmers embracing new technologies (Wiseman, 2019). Lastly, several studies have proven the model's reliability in research on technology adoption among farmers (Mwangi & Kariuki, 2015; Danso-Abbeam et al., 2017; Jain et al., 2018; Ogada et al., 2014; Adegbola & Gardebroek, 2007; Lapple & Van Rensburg, 2011). These studies show that logistic regression is effective in identifying key influences—such as demographic and socio-economic factors—that shape farmers' adoption decisions.

The binary logistic regression model is expressed as follows:

$$Log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots\ldots\ldots + \beta_p X_p + \varepsilon$$

p = probability of farmers' willingness to adopt e-commerce applications.

$\beta_0, \beta_1, \beta_2, \ldots, \beta_p$ = the coefficients corresponding to the predictor variables $x_1, x_2, \ldots, x_p$ and ε is the error term.

where:

x_1 = Age

x_2 = Gender

x_3 = Education

x_4 = Employment Status

x_5 = Occupational Sector

x_6 = Income

x_7 = Social Influence

x_8 = Farmer's Progressiveness

x_9 = Access to the internet

x_{10} = Access to Smartphones and Computers

x_{11} = User Friendliness

x_{12} = Farmer's ability to use the agricultural ecommerce,

x_{13} = Subscription

x_{14} = Extension services

x_{15} = Market

Table 2: **Variable description summary**

Unit	Variables	Variable Description	Expected Sign
Y1	Farmers' willingness to adopt e-commerce applications for their business operations.	(The goal is to determine the direction and significance of the influence)	+-
X1	Gender of the farmer.	(Gender roles and access to technology can vary)	+-
X2	Age of the farmer.	+ (Younger farmers may be more tech-savvy and open to new business models)	+
X3	Employment status (e.g., full-time farmer, part-time farmer, etc.)	+ (Full-time farmers may have more incentive to explore	+

		e-commerce due to their reliance on agricultural income)	
X4	Level of education (e.g., primary, secondary, tertiary)	+ (Higher education levels may correlate with better understanding of technology and business benefits)	
X5	Occupational sector (e.g., crop farming, livestock farming, mixed)	Different sectors may have varying needs for e-commerce solutions	+-
X6	Income level (e.g., low, middle, high)	Higher income may provide resources for investing in e-commerce and technology	+
X7	Social influence (e.g., perception of other farmers using e-commerce)	Positive perception and peer influence can encourage adoption	+
X8	Farmer's progressiveness (e.g., willingness to try new methods)	Progressive farmers are more likely to embrace innovative solutions	+
X9	Access to the internet	Essential for using e-commerce platforms	+

X10	Access to smartphones and computers	Necessary for accessing and using e-commerce applications	+
X11	Perceived user-friendliness of e-commerce platforms	Easier-to-use platforms are more likely to be adopted	+
X12	Willingness to pay subscription fees for e-commerce services	Depends on perceived value and cost-benefit analysis	+-
X13	Access to extension services that provide training on e-commerce	Training and support can increase confidence and adoption	+

Source: Author's compilation

3.9. Limitations of the study

There is a chance of sampling bias in the study because it will use a Snowball sampling technique, which means that the process of choosing participants will not be random. To reduce this bias, the researcher will write down the sampling process, admit that there are limits to it, and think about using other sampling methods or validation techniques to make the study results more reliable and strong.

3.10. Validity and reliability

3.10.1. External validity

External validity will be enhanced through conducting a pilot study. The researcher plans to execute a preliminary investigation which will involve a small-scale version of the study before the actual implementation. This will enable the researcher to find and

address potential issues with the research design, along with the methods and procedures used to collect data (Dunn, 2016). It will be useful for reefing the approach, thereby making is suitable approach for targeting the specified population. Ultimately, this process will ensure the likeliness of the results to be applicable in a wide range of individual (Kothari, 2014).

3.10.2. Internal validity

This will be achieved through content validity, which will ensure that the content of the study accurately represent the intended construct. A pretest and re-test will further be conducted through assessing the consistency and stability of the research instrument and procedures over time. This process will help in cutting any inconsistencies that may arise during the study.

3.10.3. Reliability

To enhance the reliability of the study, a pretest method will be employed, this will involve conducting a first evaluation of data before the actual study takes place, this will ensure that the results of the study are dependable and can be used for similar situations. The Cronbach's alpha will also be utilized to assert for internal consistency of the data collection tools (test reliability). Qualitative researchers commonly employ Cronbach's alpha when developing and conducting a new survey. This statistic enables researchers to pre-test the quality of the instrument during the design phase before it is fully deployed (Keith, 2018) It is a strong measure of reliability and will be fully adopted in the current study.

3.10.4. Ethical considerations

Ethical consideration is known as a set of principles that aid in guiding research practices and designs. These are principles which researchers must always abide do when collecting data (Pritha, 2021). Participants will be interviewed only if they supply their consent by signing the consent form and proving a clear understanding of the study's rationale. In cases where a participant chooses not to respond to all the interview questions, their decision will be respected, and they will be allowed to withdraw from further questioning. Ensuring the privacy of the respondents will remain

the top priority throughout the study. All participants will be assured that the information they supply will be kept confidential and will not be used for any purposes other than the research itself. Once the study is completed, participants who wish to received feedback or insights from this study will be provided at their convenience.

4.1. Introduction

The main aim of this study was to examine the awareness and adoption of agricultural e-commerce applications among smallholder farmers in the Bushbuckridge Municipality of Mpumalanga Province, South Africa. This chapter presents an analysis of the findings gathered from participants, focusing on their socioeconomic characteristics, the relationship between their awareness and willingness to adopt e-commerce applications, and the key factors influencing their willingness to adopt these technologies.

4.2. Socio-economic characteristics

The socioeconomic characteristics of smallholder farmers in the study area play an important role in shaping effective interventions and agricultural policies. These characteristics such as age, gender, education level, access to extension services, and incomesignificantly influence how farms are managed (Zondi, Ngidi, Ojo & Hlatshwayo, 2022). To better understand these attributes, descriptive statistics were used, as shown in the table below.

Table 2. **Socio-economic characteristics**

Category	Frequency(N)	Percentage (%)
Gender		
Male	61	53.5%
Female	53	46.5%
Age		
18 - 24	17	14.9%
25 - 34	36	31.6%
35 - 44	24	21.1%
45 - 54	22	19.3%
55 and above	15	13.2%
Level of Education		
No formal education	15	13.2%
Primary education	9	7.9%
Secondary Education	29	25.4%
Tertiary Education	61	53.5%
Years of Experience in farming		
0 - 2 years	27	23.7%
3 – 5 years	54	47.4%

6 – 9 years	13	11.4%
10 and above	20	17.5%
Access to extension services		
No	98	86.0%
Yes	16	14.0%
Employment Status		
Student	7	6.1%
Unemployed	55	48.2%
Employed	44	38.6%
Retired	8	7.0%
Marital Status		
Married	45	39.5%
Single	60	52.6%
Divorced	2	1.8%
Widowed	7	6.1%
Industry of Work or Study		
Information Technology	5	4.4%
Hospitality and Tourism	9	7.9%
Healthcare	10	8.8%
Agriculture	7	6.1%
Finance	12	10.5%
Education	11	9.6%
Retail	11	9.6%
Transport and Logistics	11	9.6%
Other	38	33.3%
Annual Income		
Below R100 000	38	33.3%
Between R100 000 and R300 000	63	55.3%
Above R300 000	13	11.4%
Access to Smartphones and Computers		
No	1	0.9%
Yes	113	99.1%
Number of hours spend on the internet per week		
<1	1	0.9%
1 - 5	9	7.9%
5 - 10	31	27.2%
10 - 20	25	21.9%
>20	48	42.1%

Source: Author's compilation from SPSS Survey results (2024)

The table above shows that males make up a larger proportion of the respondents (53.5%) compared to females (46.5%). This finding is consistent with results from studies conducted in other developing countries, where men tend to have greater access to resources and opportunities than women (Asamu et al., 2020). However, the participation of women in this study also underscores their vital role in agriculture. This highlights the importance of developing and marketing digital tools that are

inclusive and responsive to the unique challenges female farmers face, such as limited access to information and technology (Chagomoka et al., 2015).

In terms of age distribution, 31.6% of respondents fall within the 25 to 34 age group, suggesting that a significant portion of the farming community is relatively young and likely to be tech-savvy. This creates a favourable environment for the adoption of agricultural e-commerce platforms in the future. Foster and Rosenzweig (2010) support this, noting that younger farmers are generally more inclined to adopt innovative practices, a point that aligns well with this study's focus on digital readiness.

Education levels also indicate a positive outlook for e-commerce adoption, as 53.5% of respondents have attained higher education. Research shows that individuals with formal education are often more open to using new technologies (Duflo et al., 2018). However, the 13.2% of farmers who have never attended school may require additional training or more user-friendly digital interfaces to fully benefit from online agricultural platforms.

Despite these encouraging indicators, 86% of respondents reported not having access to agricultural extension services. This lack of professional guidance can limit awareness and understanding of available digital solutions (Gupta, 2023). Furthermore, nearly half of the farmers (48.2%) are unemployed, indicating that farming serves as their primary source of livelihood, an important factor given the high poverty levels in the region (Lindumusa & Mokhele, 2020).

In terms of income, 33.3% of respondents earn less than R100,000 per year. This financial limitation could restrict their ability to afford smartphones, internet access, or premium features on agricultural e-commerce platforms (Barrett, Reardon & Webb, 2001). Nonetheless, the findings show that 99.1% of participants own either a smartphone or a computer, which is a promising indicator for digital adoption. Additionally, more than 40% of farmers spend over 20 hours online weekly, suggesting a strong level of digital engagement.

Overall, the demographic profile presents both opportunities and challenges for agricultural e-commerce adoption in Bushbuckridge. On the positive side, the high

education levels, youth involvement, and widespread smartphone ownership create a strong foundation for digital transformation. However, barriers such as limited access to extension services and financial constraints must be addressed to ensure that all farmers can participate fully in the digital agricultural economy.

4.3 Awareness of Agricultural E-commerce Applications

For smallholder farmers to be able to join modern agricultural markets, boost their productivity, and get better access to market information, they need to know about agricultural e-commerce applications. Farmers can reach more customers, get better prices for their goods, and cut down on the problems that come with traditional ways of marketing their goods by using e-commerce apps (Gupta, 2023; Jayne et al., 2014). The researcher applied descriptive statistics to understand awareness. The results can are as follows:
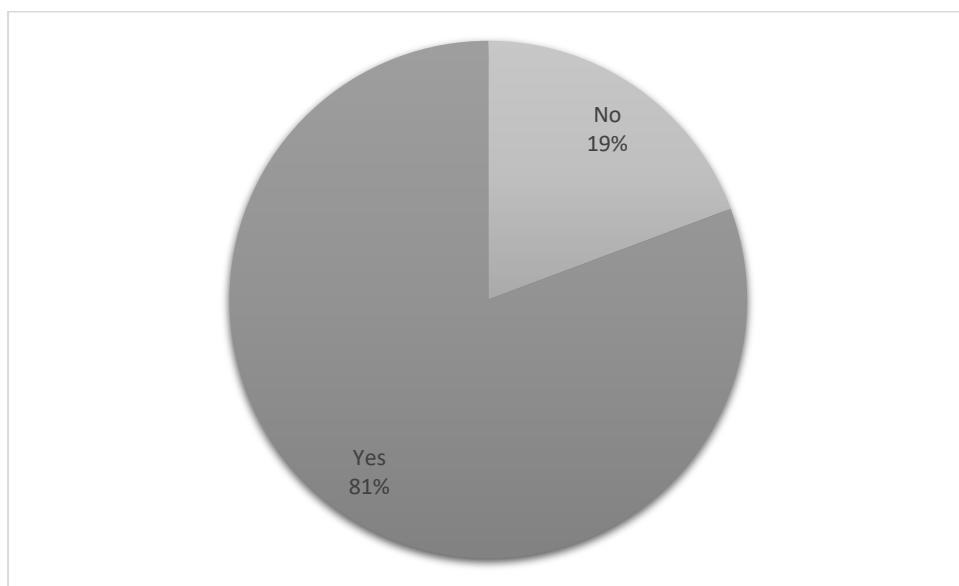
*Figure 1: **Awareness of agricultural e-commerce applications***

Source: Author's compilation from SPSS Survey results (2024)

Majority of smallholder farmers in the study area know about agricultural ecommerce apps. 80.7% of them say they do, while 19.3% say they don't. This means that a lot of people in this community are using digital farming tools. This high level of awareness shows that many farmers already know how online platforms can help them sell their crops, find inputs, or get market information. From the study's point of view, this level of familiarity makes it easier for

farmers to start using e-commerce because it makes it easier to explain the idea to them. However, the 19.3% who are still unaware show that there is a need for targeted outreach or training to make sure that all farmers, no matter how much they already know, can benefit from digital solutions. So, even though the high level of awareness is a good sign, it is important to fill in the gaps in knowledge if e-commerce platforms are going to have a big and fair effect on the community.
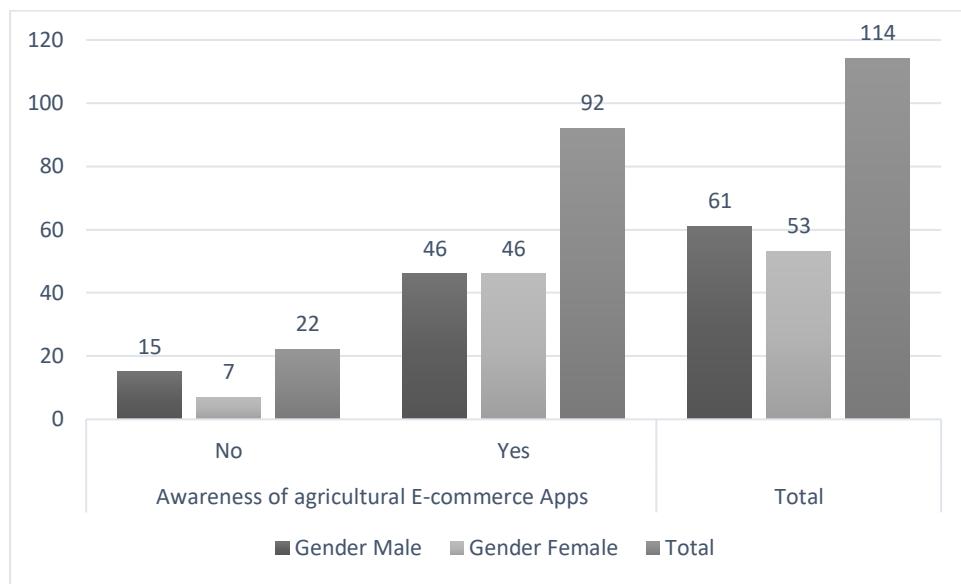
Figure 2: **Gender vs Awareness**

Source: Author's compilation from SPSS Survey results (2024)

When it comes to age, younger farmers, especially those between the ages of 25 and 34, are the most aware (28 out of 36). Next are farmers between the ages of 35 and 44 (21 out of 24). People tend to be less aware as they get older. The 55 and older group had the lowest level of awareness (12 out of 15). Younger farmers are more likely to know how to use computers and be open to new technologies, which is why they are more aware (Foster & Rosenzweig, 2010).
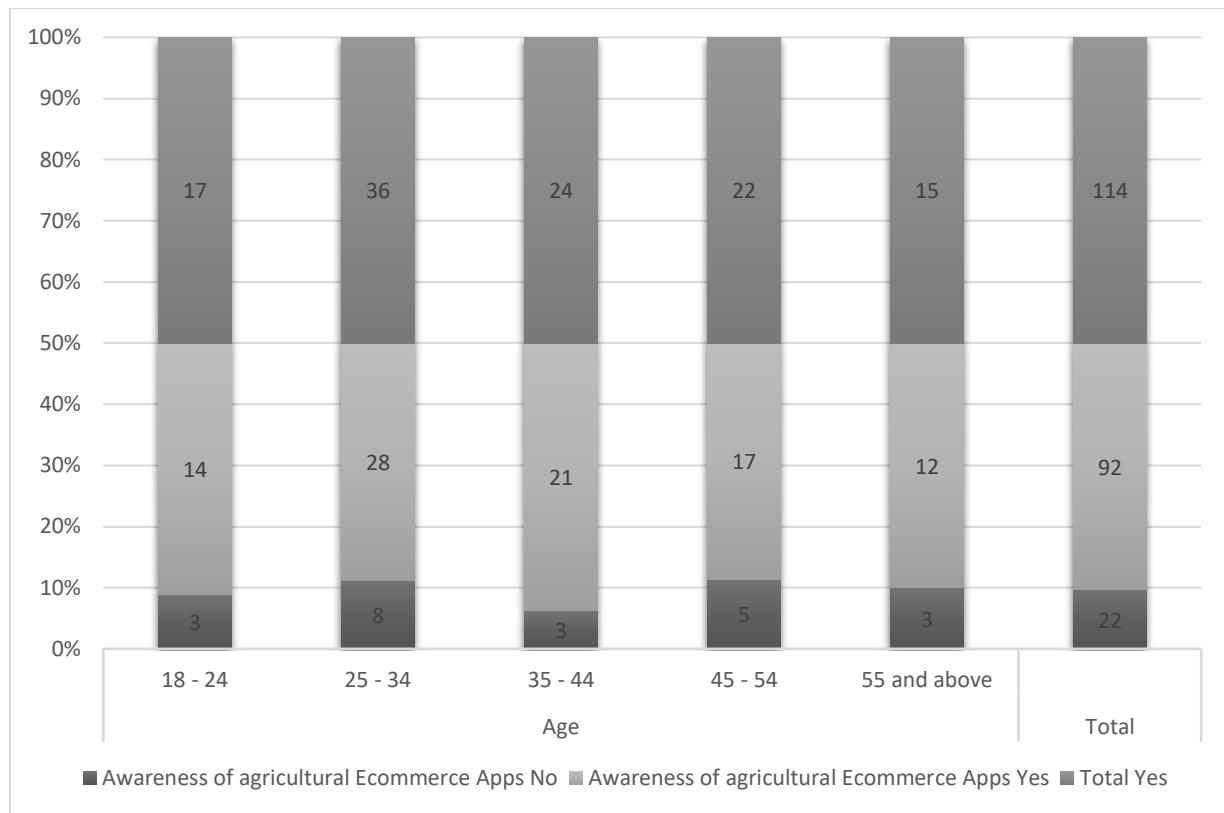
Figure 3: **Age vs Awareness**

Source: Author's compilation from SPSS Survey results (2024)

Both genders show an almost equal distribution of awareness of these ecommerce apps (75.4% of men and 86.8% of women). This suggests that both parties are likely to adopt these digital tools.
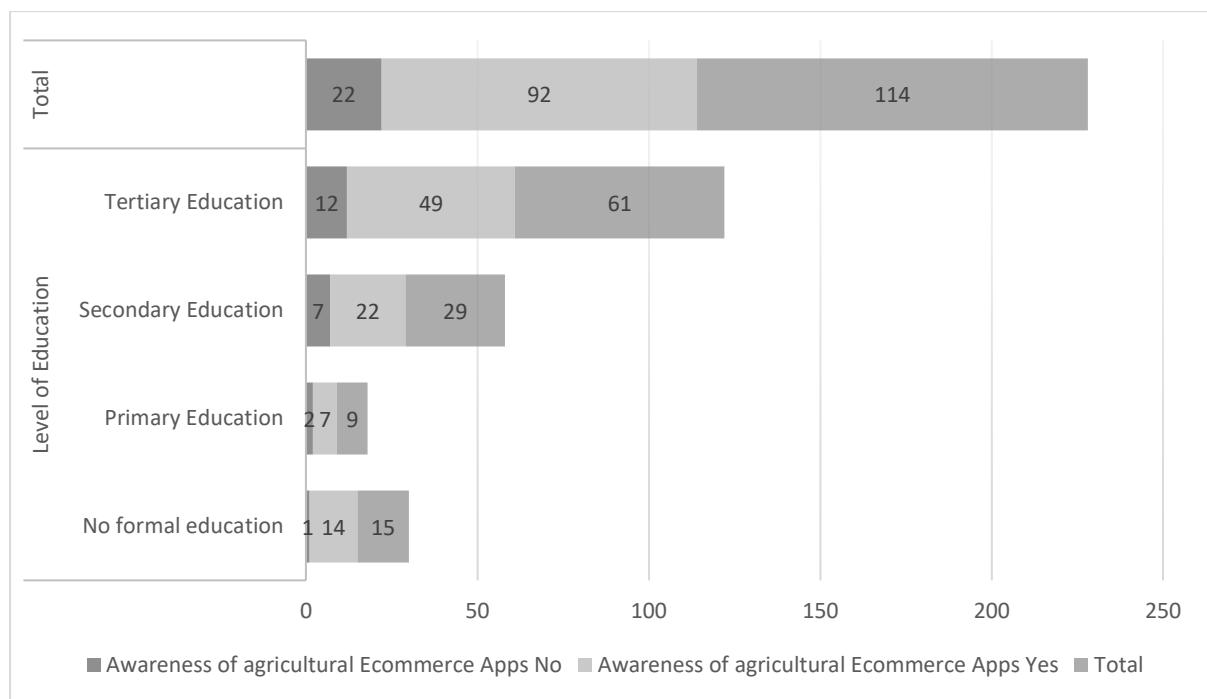
Figure 4**: Education vs Awareness**

Source: Author's compilation from SPSS Survey results (2024)

High education attendance indicates the likelihood for awareness of e-commerce apps. Farmers with tertiary (49/61) education, followed by those with secondary (22/29), have shown the most awareness. This also shows that education is imperative for enhancing digital literacy (Duflo et al., 2018).
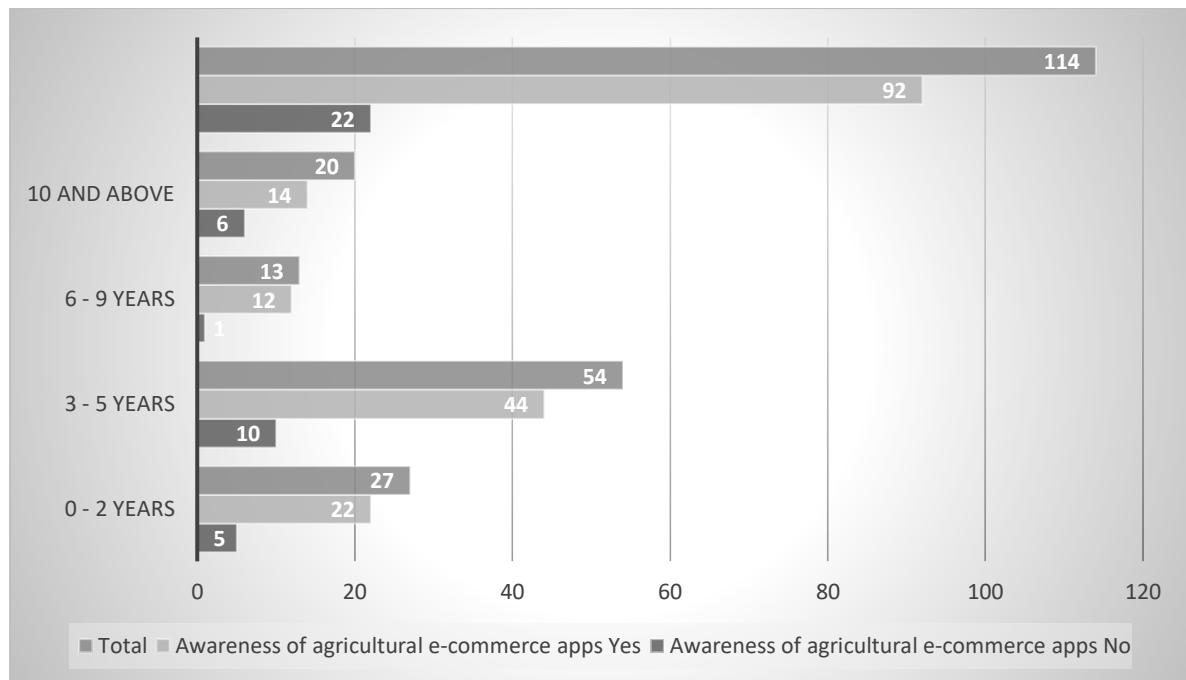
Figure 5: **Experience vs Awareness**

Source: SPSS version 29 Survey results (2024)

Both experienced (44/54) and inexperienced (22/27) farmers are aware of these e-commerce applications; this suggests that regardless of the experience, farmers may still keen to adopt new technologies to improve their farming practices.
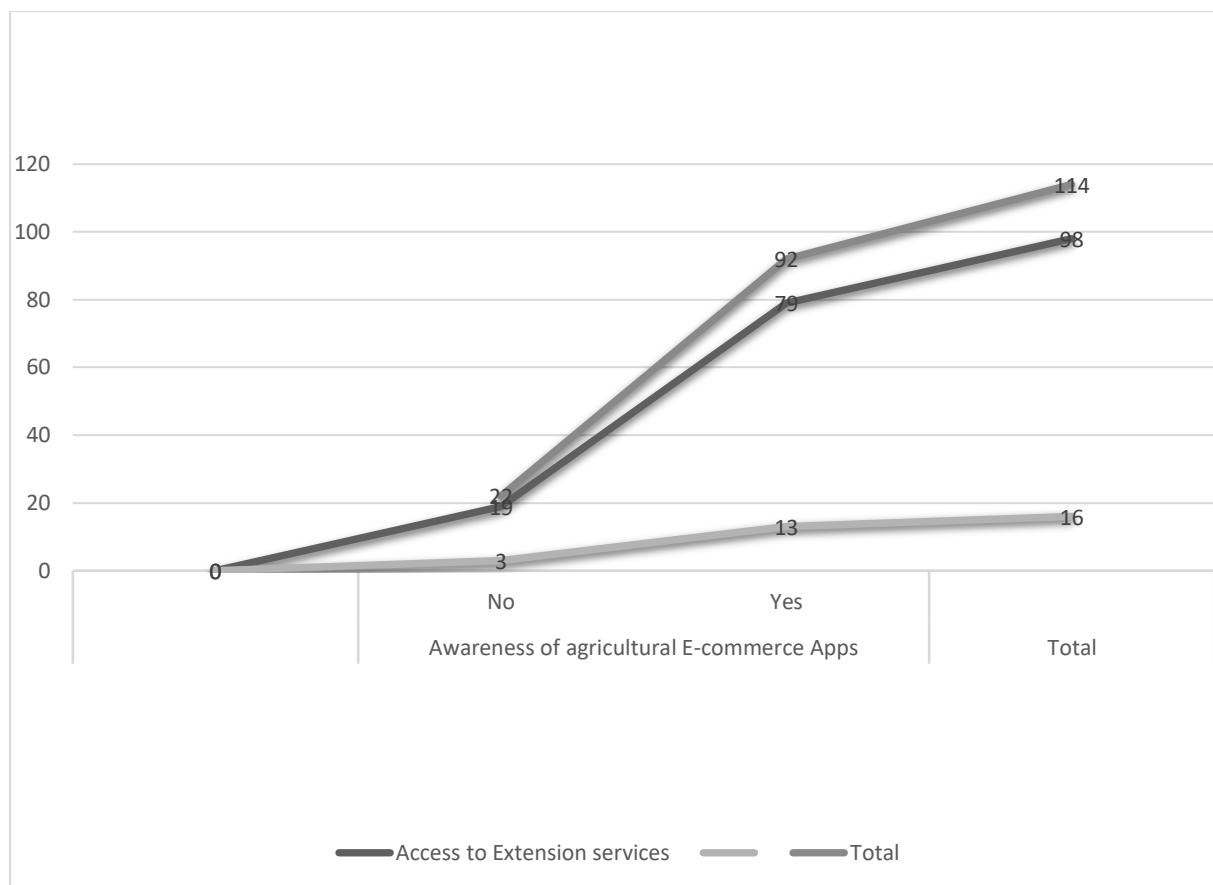
Figure 6: **Extension vs Awareness**

Source: SPSS version 29 Survey results (2024)

Farmers who have access to extension services are more aware (13/16) as compared to those that don't have access (79/98). This means that agricultural extension services are important for creating awareness about e-commerce technologies (Gupta, 2023).
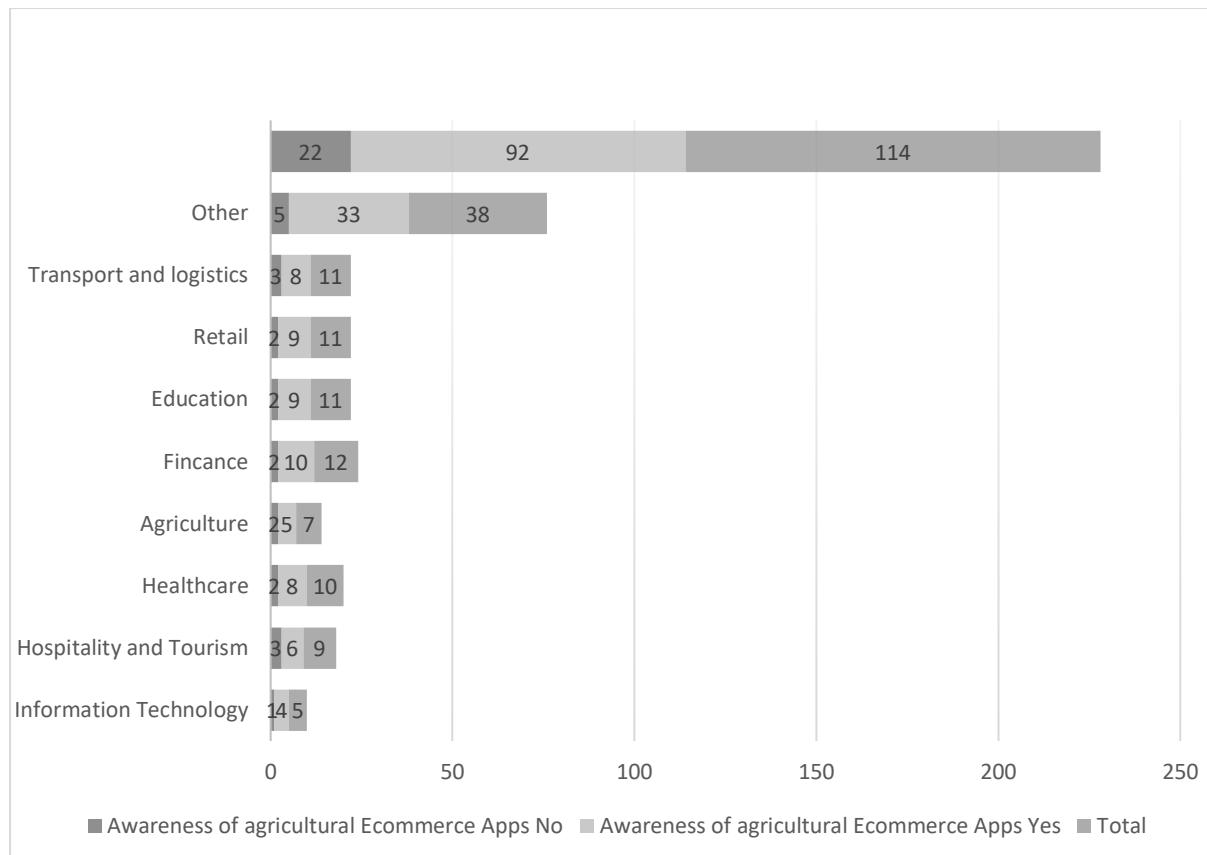
Figure 7**: Work Industry vs Awareness**

Source: SPSS version 29 Survey results (2024)

Farmers who are unemployed are the most aware (43/55). This could be because they depend on farming for most of their income and need to use digital tools to reach more customers and make more money.

Source: SPSS version 29 Survey results (2024)

Access to smartphones and computers is almost the same among farmers who are aware (92/113). This high digital connectivity is essential for the adoption and effective use of e-commerce applications (Jones et al., 2014).
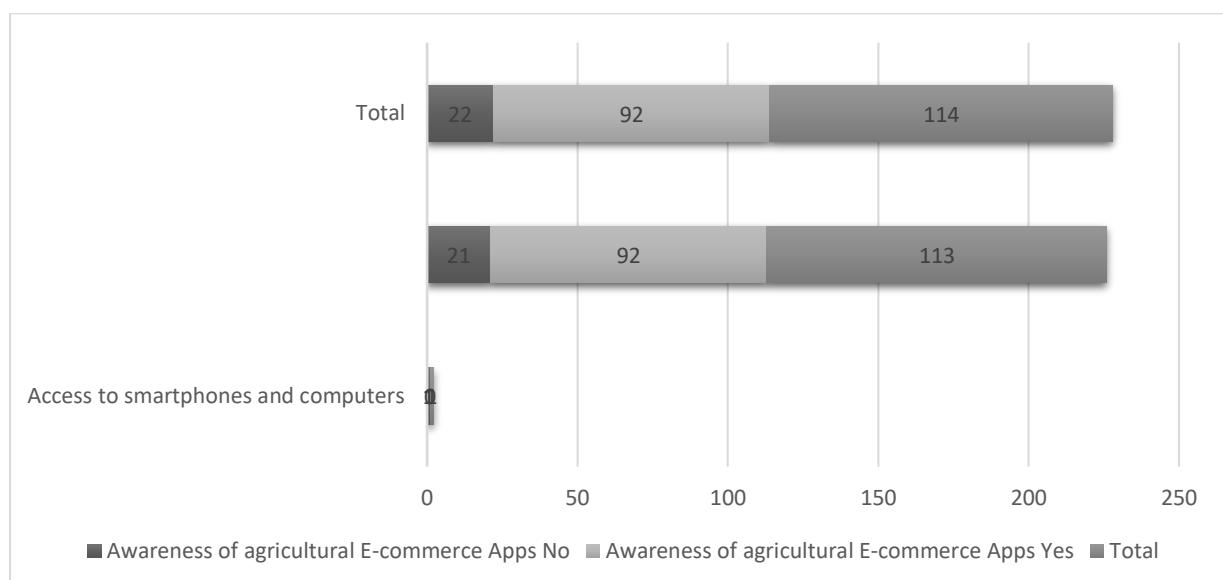
4.4. Relationship between Awareness of agricultural E-commerce and Farmer's willingness to adopt

To promote the use of technology in agriculture, it's important to understand how smallholder farmers' knowledge of agricultural e-commerce apps affects their willingness to use them. Awareness affects how farmers see the benefits and features of these apps, which in turn affects how willing they are to use these technologies in their farming. Chi-Square tests were used to look at the link between awareness and willingness to use agricultural e-commerce apps. The table below shows the results:

Table 3: Relationship between awareness and willingness to adopt agricultural e-commerce apps

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.783[a]	1	.182		
Continuity Correction[b]	.708	1	.400		
Likelihood Ratio	3.109	1	.078		
Fisher's Exact Test				.343	.213
Linear-by-Linear Association	1.768	1	.184		
N of Valid Cases	114				

a. 1 cell (25.0%) has an expected count of less than 5. The minimum expected count is 1.35. b. Computed only for a 2x2 table
Source: SPSS version 29 Survey results (2024)

The Chi-Square tests indicate that the relationship between awareness of agricultural e-commerce applications and willingness to adopt them is not statistically significant at the conventional levels ($p < 0.05$). The Pearson Chi-Square value of 1.783, with a significance level of 0.182, indicates that we do not reject the null hypothesis (H0), signifying no significant correlation between awareness and willingness to adopt. Previous studies indicate various factors contributing to the absence of a statistically significant relationship between awareness of agricultural The study focuses on e-commerce applications and the willingness to adopt them. A study by He et al. (2018)

revealed that even though farmers are aware of technologies, they may still lack the means to introduce them to their practices. This could be due to challenges like the costs associated with adopting them and not having financial assistance.

4.5. Factors influencing farmers' willingness to adopt agricultural e-commerce applications.

The table below indicates the results, and further down is a discussion of the factors that affect smallholder farmers' willingness to use agricultural e-commerce apps in Mpumalanga, South Africa. Understanding these factors is crucial for enhancing the adoption of e-commerce applications in agriculture, as they aid in improving productivity, access to market and ensuring sustainability. The results are drawn from a binary logistic regression model; along with the discussion, they provides an understanding in relation to other studies.

Table 4: Factors influencing farmer's willingness

Variable	Test Statistic	Scores	Df.	Significant
Age	2.19	1.864	1	0.012
Gender	0.01	0.001	1	0.974
Level of Education	0.12	0.017	1	0.896
Years of Experience in Farming	0.18	0.054	1	0.816
Access to Extension Services	0.00	0	1	0.984
Employment Status	0.87	0.906	1	0.341
Marital Status	1.15	1.264	1	0.261
Industry of Work or Study	0.11	0.075	1	0.785
Annual Income	0.35	0.109	1	0.741
Access to Smartphones and Computers	0.16	0.066	1	0.797
Hours Spent on the Internet per Week	2.02	4.639	1	0.031
Farmer's Progressiveness	5.08	25.288	1	0.001
Usability	2.10	3.869	1	0.049
Digital Literacy	3.21	10.523	1	0.001
Subscription	0.75	0.425	1	0.514
Market		1.049	1	0.306
Overall		46.467	16	0.001
R^2	0.652			
Adjusted R^2	0.639			

() denote statistical significance at the 0.05 level.
Source: SPSS version 29 survey results (2024)

The results shown above outline factors that affect farmers' willingness to adopt agricultural e-commerce applications using a binary logistic regression model. It has been revealed that there is a high number of farmers who have indicated that they are willing to adopt e-commerce solutions, therefore indicating a favourable outcome on the adoption of these tools in Bushbuckridge Local Municipality. The analysis of these results indicated that the model explained 65.2% of the variance ($R^2 = 0.652$). Which means that 65.2% of the respondents are willing to adopt.

4.5.1. Discussion of Significant Variables

Age (p = 0.012)

The likelihood of farmers being able to adopt e-commerce apps indicates a considerable difference with age, thereby outlining that farmers who are young are more inclined to try out e-commerce solutions. This shows that young farmers are comfortable using technologies or are open to bringing an improvement to the farming practices (Czaja et al., 2018).

Number of hours spent per week on the Internet (p = 0.031)

Farmers who spend a lot of time browsing through the internet are likely to adopt agricultural ecommerce apps. This indicates that access to the internet helps foster awareness, and the likelihood that these farmers may know how to actually use the platform is high because they already probably interact with other apps; therefore, they can transfer that skill to the ecommerce apps (Wang et al., 2018). In other words, when farmers use the internet a lot, they may come across ads or content that surrounds these tools, therefore increasing their chances of seeing them as more useful.

Farmers' progressiveness (p < 0.001)

Smallholder farmers who are actively looking for new ways to improve their farming practices are more likely to adopt agricultural ecommerce apps, because they often explore different innovative methods to help increase their income and productivity. This shows that if there are certain programmes tailored to help farmers explore innovative solutions, they would be motivated to try them out (Kumar et al., 2020).

Usability of the platforms (p = 0.049)

There's a high chance that farmers will use ecommerce apps, provided that they are easy to navigate. Therefore, apps that have simple user interfaces make it easy for people to want to adopt them. This is true in areas where there's a gap in digital literacy skills (Nyagwencha et al., 2019). Therefore, improving app designs to make them easy to use can help with increasing adoption.

Digital Literacy (p = 0.001)

The capability to use technology is one of the reasons people adopt it. Farmers who have digital literacy skills were still able to see the advantages of these platforms. Farmers who lack digital literacy skills are less likely to adopt them (Johnson & Brown, 2021). Therefore, things like workshops and digital literacy training should be implemented to help close the gap and enhance adoption.

The binary logistic result outlined indicates that smallholder farmers in the study areas have various reasons for adopting e-commerce applications. Socio-economic characteristics like age have been shown to have an impact on whether farmers are willing to adopt, as have internet usage, progressiveness of farmers, and digital literacy, outlining their importance in the adoption. Therefore, there should be policies, interventions, and tools and trainings tailored for this purpose to help enhance the adoption rate, as it will help increase overall productivity and profit within the farming communities.

4.6. Discussion

The results of this study showcase an almost balance in terms of gender, which indicates that there's an improvement in terms of gender inclusiveness, but there's still more work that needs to be done to ensure that there's an equal distribution of opportunities as well as resources by both genders. Because education plays a positive role in productivity, farmers are likely to handle new technology and also adopt them. This is in line with a study conducted by Duflo et al. (2018) and Foster & Rosenzweig (2010), as they found that education plays a vital role in the outcomes of farming. Moreover, the involvement of younger farmers helps increase the likelihood

for adoption, this is because younger farmers have high chances of trying out new innovations that prove to be beneficial to their practice and are more digitally literate as compared to older farmers.

The results of the study indicate an almost equal distribution of emerging and experienced farmers, this shows that there's diversity among smallholder farmers within the study area, this increases the chances for more experienced farmers to provide mentorships to the emerging farmers. According to Moyo et al. (2017), there's a huge advantage when there are farmers with a variety of experience levels within a community, as those with more knowledge and skills can provide guidance for those without; this will help improve the outcomes of farming in the community. This diversity can actually enhance an ongoing learning among farmers, which is crucial for agricultural growth.

Access to extension services seems to be an ongoing problem, as there are few who have access to them. Therefore lowering the chances of increasing agricultural productivity as well as profitability. As per Gupta (2023), it is crucial for farmers to have access to these services, as they are effective when it comes to enhancing adoption of innovative tools. There is a high number of unemployed individuals drawn from the results of the study; it is therefore crucial to introduce other sources of funds, as solely relying on farming can be risky due to circumstances like economic and environmental uncertainties (Lindumusa and Mokhele, 2020). Diversifying income can help in minimizing such uncertainties and help one stay ahead. Not only that, but it provides farmers the ability to afford investing in tools or ideas that can help raise profit in their farming practices.

There's a wide variety of professional backgrounds that these farmers emerged from, thus giving the agricultural industry different sets of skills and knowledge. This diverse professional background comes with an advantage, as more ideas may emerge from it, and it also improves productivity. However, that instability shown in income is a significant challenge; many farmers cannot afford inputs or even produce their desired yield. This instability affects both their profits and overall efficiency. As per Barrett, Reardon, and Webb (2001), it is crucial to provide farmers with access to financial assistance to help solve such issues.

Framers who spend most of their time on the internet are prone to adopting tools that aid in improving their farming activities, including having a large customer based and receiving more education. A study by Jones et al. (2014) places an emphasis on the importance of being connected to the internet for agricultural purposes; they stated that it can help distribute news about potential markets, pricing and decision-making processes. If farmers have access to these, their farming activities may be improved. For these farmers to trade their produce on the internet, it is imperative for them to have knowledge about how e-commerce applications work. Having younger farmers as well educated and willing to adopt these new tools, there is a high chance that they are aware of them. Because Foster & Rosenzweig (2010) and Duflo et al. (2018) outline a positive correlation between youth, education and technology adoption as well as awareness.

Agricultural extension services play a role in raising awareness, which helps improve support systems in agriculture. A study by Gupta (2023) stated that extension services play a crucial role in educating farmers about the benefits of e-commerce applications, along with how they actually work or function; this therefore increases the chance for adoption. There's a balance when it comes to women and men being aware of e-commerce applications; such awareness is important for ensuring inclusivity in agriculture (Chagomoka et al. 2015). Ensuring that both genders have equal opportunities to access these tools as well as resource aids in collaborative work between both parties, therefore increasing overall efficiency in agriculture.

The relationship between awareness and income indicates that it is not simple for low-income farmers to adopt new tools due to financial constraints. To ensure that smallholder farmers don't encounter these challenges, regardless of their income, and can actually benefit from these tools, they should be provided with financial assistance and training programmes tailored to their needs (Barrett, Reardon, and Webb, 2001). This is advantageous and may help assist these farmers, therefore increasing their income and productivity.

CHAPTER 5: SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1. Introduction

This chapter focuses on providing a summary of the findings of the study and further suggests actionable steps and areas that need more research.

5.2. Summary of Major Findings

The first chapter addresses the problem statement by stating that smallholder farmers, especially those in rural areas, don't use agricultural ecommerce apps that much, even when they are aware of them and their benefits. After a thorough review of the literature in Chapter 2, the study pinpointed significant theoretical frameworks, including the Technology Acceptance Model and the Resource-Based Theory, which emphasise the significance of user-friendliness, resource accessibility, and socio-economic factors in technology adoption.

The third chapter talked about the cross-sectional design and quantitative approach. It explained how data were collected with a structured questionnaire and then analysed in SPSS (version 29). Chapter 4 then showed descriptive statistics that showed a farming community with a wide range of demographics, a nearly equal number of men and women, and a fairly high level of education. This suggests that farmers are generally well-prepared to use new technologies. It is important to note that 80.7% of the participants said they knew about agricultural e-commerce tools, but a Chi-square test showed that just knowing about them didn't mean they were willing to use them.

The binary logistic regression model in Chapter 4 pinpointed five critical factors influencing the willingness to adopt: age, online hours, the farmer's progressiveness, app usability, and the perceived capability to utilise the application. These results show that general infrastructure or socio-economic conditions are important, but individual factors like openness to innovation, digital exposure, and skills are even more important in deciding whether or not to use e-commerce. The lower significance of various demographic variables, such as gender or education reveal that willingness to adopt is not solely a matter of formal qualifications but also attitudes toward change and regular interaction with digital tools.

5.3. Conclusion

This study shows that even though a lot of smallholder farmers in Bushbuckridge know about agricultural e-commerce platforms, more people will use them if certain factors are in place. So, policymakers, extension officers, and companies that make technology should think about the specific needs and wants of farmers in order to get the most out of agricultural ecommerce apps.

5.4. Recommendations

The results of the study indicated several areas that need to be addressed in order to improve productivity, profitability and sustainability of smallholder vegetable farmers in Bushbuckridge Local Municipality. The following recommendations are meant to help overcome barriers identified in the study.

Improve access to extension services

Access to extension services poses as one of the challenges faced, therefore affecting the awareness of these tools and farmers from adopting them. Government agencies and non-governmental organisations (NGOs) should use a mix of traditional field visits and digital platforms to help farmers learn more about how to use e-commerce tools.

Enhance Digital literacy programs

Because there is a link between using the internet and being willing to adopt new technologies, targeted digital literacy training could help farmers become more skilled and confident in using e-commerce sites. Partnerships among agricultural departments, local universities, and private software firms could generate context-specific training materials.

Focus on the usability of the application.

Usability had a big impact on decision-making, which means that developers need to make e-commerce sites with easy-to-use, intuitive interfaces, and maybe even in the local language. Adding user feedback to the development process can help make sure that these platforms really meet the needs of smallholder farmers.

Involve more younger and progressive farmers.

Progressive farmers and youth are likely to adopt new technologies; therefore, involving them in pilot programmes could help increase the engagement, as these individuals will serve as role models to those sceptical to adopt. Therefore, more people within the rural communities would be prone to adopt.

Diversify income and provide access to financial assistance

The majority of the farmers mentioned that they struggle with adoption due to financial constraints. Options such as microloans, low-interest credit or subsidies should be implemented to help cover upfront costs; this would assist farmers who do not have the means to enter the markets, particularly those earning less.

Suggestions for further research

Further research studies could focus on factors that influence the adoption of ecommerce apps that pertains to profitability, productivity and the livelihoods of smallholder farmers. Other studies could focus on the experiences and challenges that are faced by women as compared to men when it comes to the awareness and willingness to adopt agricultural ecommerce applications, since there's gender disparity. Moreover, a comparative analysis among various municipalities or provinces may uncover region-specific factors affecting technology adoption, this can help with providing insights that focus on geographically tailored interventions.

Overall, this chapter brings together the findings, conclusions, and recommendations to showcase the adoption of ecommerce apps adoption is a complex process that can't be done with just new technology. Ecommerce solutions can only reach their full potential to increase productivity and improve livelihoods when they are closely aligned with farmers' social realities, levels of digital literacy, and economic contexts

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APPENDIX

Actual Research Instrument

Cape Peninsula
University of Technology

Dear Respondent

My name is Progress Lefsifi, studying my master's degree at the Cape Peninsula University of Technology, Faculty of Applied Science, Department of Agriculture. I hereby request your permission to conduct an interview on the topic Awareness and adoption of agricultural e-commerce applications by smallholder farmers in Bushbuckridge Local Municipality, Mpumalanga Province. The purpose of this research is to assess the awareness of agricultural ecommerce Applications by Smallholder Farmers and their willingness towards adopting them.

Your participation in this study is voluntary and you free to withdraw from taking part without providing a reason. The information that you are to provide me with shall remain confidential and will not be used for other purposes.

Thank you.
Lefsifi P
CONSENT FORM

The consent form is designed to confirm that you understand the purpose of the study, your rights as a respondent and that you have agreed to take part in the study. Please read and complete this form carefully. Mark an (X) on the relevant box corresponding with your answer.

NB: Should you be unhappy about how the study is conducted, you can report the case to CPUT research ethic chair: Prof Sjirk Geerts (geertss@cput.ac.za).

	YES	NO
I confirm that the nature of the study has been described to me		
I understand that taking part in this study is voluntary and I am free to withdraw from taking part without supplying a reason		
I understand that the information I provide shall be treated with confidence		
I agree to take part in the study		

Signature ……………………   Date ……………………

Please fill your name _____ Contact details

Section A

Socio-Economic characteristics

1. How old are you?

   ○ 18-24

   ○ 25-34

   ○ 35-44

   ○ 45-54

   ○ 55-64

   ○ 65 and more

2. Gender

   ○ Woman

   ○ Man

3. What is the level of education reached?

○ No formal education

○ Primary education

○ Secondary

○ Tertiary

4. Years of experience in farming

0-2
○

3-5
○

6-9
○

10   or more
○

5. Do you receive extension services?

○ Yes

○ No

6. What is your current employment status?

○ Student

○ Unemployed

○ Part-time

○ Full-Time

○ Retired

7. What is your marital status?

◯ Married

◯ Single

◯ Divorced

◯ Widowed

8. If you did not mention select Unemployed, what is your industry of work or study?

○ Information Technology (IT)

○ Hospitality and Tourism

○ Healthcare

○ Manufacturing

○ Finance and Banking

○ Education

○ Retail

○ Construction

○ Automotive

○ Agriculture

○ Transportation and logistics

○ Other

_____

9. What is your annual income?

   ○ Below R 100,000

   ○ Between R 100,000 and R 300,000

   ○ Above R 300,000

10. Do you have access to smartphone or computer?

○ Yes

○ No

11. How many hours do you spend using internet per week?

○ Less than an hour

○ 1 to 5 hours

○ 5 to 10 hours

○ 10 to 20 hours

○ 20 to 30 hours

○ More than 30 hours

Section B

Awareness of agricultural e-commerce Applications by Farmers

1. Are you aware of agricultural ecommerce Application that you can use in your farming activities?

○ Yes

○ No

2. If you are aware, how did you find out about them?

☐ Friends or Family members

☐ Fellow farmer

☐ Colleagues

☐ Other _____

3. What apps are you aware of?

Section C

Farmers' willingness to adopt agricultural ecommerce application.

1. Would you be willing to adopt these apps?

○ Yes

○ No

2. If yes, why?

☐ Market access

☐ Information access

☐ Storage and Management of farm records

☐ Extension services

☐ Other _____

3. If no, why

☐ Preference for Traditional Methods

☐ Cost and Affordability

☐ Difficult to understand.

☐ Other,

4. List other factors that influence both the adoption and non-adoption of these apps on your farming activities.

Adoption factors	Non-adoption factors

5. Rank the factors according to their importance

Adoption factors	Non-adoption factors

Research planning: Timetable

Item	Date
Full Proposal	01 January 2024
Chapter 2: Literature Review	31st January 2024

Chapter 3: Research Methodology	28th February 2024
Data Collection, Coding, SPSS	30th March 2024
Chapter 4: Research Analysis	31st April 2024
Chapter 5: Conclusions and Recommendations	30th May 2024
Submissions: First Draft	30th June 2024
Final Draft	30th July 2024
First Article Submission	15th August 2024