ENTREPRENEURSHIP, MARKET ACCESS AND THE ROLE OF WATER SECURITY IN URBAN-BASED FARMING

By

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ABSTRACT

Due to the growing urban population and the need for food, urban farming (UF) has gained support and appeal globally in recent years. UF has gained attention from researchers due to the growing need for food in urban areas, and the COVID-19 pandemic constraints revealing the weakness of urban agri-food systems in developing countries. Urban residents have chosen to use their agricultural expertise to combat poverty due to unemployment and limited livelihood options in urban settings, which has led to the growth of UF. Through the construction of short food supply chains, job possibilities, and biodiversity enhancement, UF has enormous potential for social, economic, and environmental development. Urban-based farming has become essential to environmental sustainability, economic growth, and food security. As more entrepreneur's venture into the urban agricultural sector, market access and water security become crucial to their success. There are opportunities and problems at the nexus of market accessibility, water security, and entrepreneurship. On the one hand, urban farmers have a large market potential due to the rising demand for food produced locally. However, their potential is constrained by poor infrastructure, scarce water supplies, and obstacles to market access.

By thoroughly examining the effects of market accessibility and water security on urban farming entrepreneurs, this study seeks to shed light on tactics that can promote the growth of resilient, sustainable urban agriculture ecosystems. The specific objectives of the study were to (i) identify the determinants of market participation decisions and level of market participation among smallholder urban vegetable farmers. (ii) determine the drivers of agricultural entrepreneurship among smallholder urban vegetable farmers. (iii) assess the role of water security on market access and entrepreneurship among smallholder urban vegetable farmers. (iv) explore the relationship between water security, market access, and entrepreneurship among smallholder urban vegetable farmers. The study used primary data, which was collected from a total of 156 smallholder urban vegetable farmers who were selected using multi-stage sampling. The study focused on two areas in the Province of KwaZulu-Natal, namely Sobantu Township, which is an urban area, and Mphophomeni Township, which is a peri-urban area.

While analyzing the factors affecting the decision of smallholder urban vegetable farmers to participate in the market, the logistic model revealed that market participation decision among smallholder urban vegetable farmers was significantly influenced by credit use, access to market information, access to labour, and owning a smartphone. Moreover, the fractional

response model revealed that the level of market participation among smallholder urban vegetable farmers was significantly influenced by age, cooperative membership, free input, storage, and market training. The study also investigated the factors influencing agricultural entrepreneurship among smallholder urban vegetable farmers. The agricultural entrepreneurship index was created using principal component analysis and used as a dependent variable to determine factors influencing agricultural entrepreneurship in a two-step generalized least-squares (GLS) model for dealing with multiplicative heteroskedasticity. The results indicated that entrepreneurial spirit, entrepreneurial attitude, farming interest, gender, education, farming information, selling produce, and the distance to input suppliers were significant factors that influenced agricultural entrepreneurship among smallholder urban vegetable farmers in the study areas.

The study further investigated the entrepreneurship, market access, and water security nexus in the context of smallholder urban farming using a Structural Equation Modelling (SEM) approach. The results revealed a significant inverse relationship between water security and entrepreneurial engagement, suggesting that higher water security may reduce the motivation for risk-taking and innovation among farmers. Conversely, market access did not have a statistically significant influence on entrepreneurship underscoring the need to explore other factors that might be more critical in driving entrepreneurship. These findings challenge conventional assumptions and highlight the need to consider local barriers beyond resource availability, such as market conditions and institutional support. This study contributes to the understanding of the complex association between entrepreneurship, market access, and water security, highlighting the complex dynamics influencing entrepreneurship in the urban agricultural sector and suggesting policy interventions to address non-resource-related constraints on entrepreneurial growth. The results point to an essential nuance in the Theory of Planned Behaviour (TPB), where resource availability, while facilitating operational aspects, might reduce the perceived necessity for entrepreneurial action.

This study recommends that local municipalities should develop urban policies and programs that strengthen market training activities and form farmer co-operatives to meet market requirements and improve market participation among smallholder urban farmers Support institutions must be strengthened immediately because of the impact that institutional elements have on the agricultural production systems smallholder farmers. This might entail setting up strong extension services, offering technical support, and making credit and storage facilities more accessible. Furthermore, the study recommends urban policies and programs that

strengthen urban farming activities, market information sources, and entrepreneurship training to improve agricultural entrepreneurship endeavors among smallholder urban farmers. It is suggested that conducting longitudinal studies would be beneficial in tracking how changes in resource availability, such as land, water access, and market conditions, influence entrepreneurial activities over time.

Keywords: Entrepreneurship, Market Access, Water Security, Smallholder Urban Farmers, Market participation, Urban Farming.

Declaration 1

I, **Phiwokuhle Ndlovu,** declare that:

• The research reported in this dissertation, except where otherwise indicated, is my original research.

• This dissertation has not been submitted for any degree or examination at any other university.

• This dissertation does not contain other persons' data, pictures, graphs, or other information unless expressly acknowledged as being sourced from those persons.

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Signed [redacted] **Date**

07/08/2025

Phiwokuhle Ndlovu

As Research Supervisor, I agree to the submission of this dissertation for examination.

Signed [redacted] **Date**

07/08/2025

Prof. Joyce Chitja

As Co-supervisor, I agree to the submission of this dissertation for examination.

Signed **Date**

[redacted] 07/08/2025

Dr Temitope Ojo

Declaration 2: Publications

The following papers are part of this doctoral Thesis and are planned for publication:

Publication Manuscript 1: Published

Ndlovu, P.N., Thamaga-Chitja, J.M. and Ojo, T.O., 2024. Drivers of the level of market participation among smallholder urban vegetable farmers in KwaZulu-Natal, South Africa. *Cogent Food & Agriculture*, *10*(1), p.2437139.

Publication Manuscript 2: Under Review

P. N. Ndlovu, J.M. Thamga-Chitja and T.O. Ojo. The Role of Water Security in, Market Access, Entrepreneurship and Food Security in Urban-based Farming. A critical review.

Publication Manuscript 3: Under Review

P. N. Ndlovu, J.M. Thamga-Chitja and T.O. Ojo. Drivers of agricultural entrepreneurship among smallholder urban vegetable farmers in KwaZulu-Natal, South Africa.

Publication Manuscript 4: Paper in preparation

P. N. Ndlovu, J.M. Thamga-Chitja and T.O. Ojo. The role of water security on entrepreneurial engagement and market access among smallholder urban vegetable farmers in KwaZulu Natal Province: a structural equation modeling approach.

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Dedication

This Thesis is dedicated to my mother, **Thandeka Lorraine**. You are the most persevering person that I know. This Thesis is for all the sacrifices that you have made for your children. Your love and dedication to your children and grandchildren are overwhelming, and we are blessed to have you. May God bless you and keep you!

"Mama I made it"

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List of Acronyms and Abbreviations

UF	Urban Farming
FAO	Food and Agriculture Organization
SDGs	Sustainable Development Goals
COVID-19	Coronavirus disease 2019
UN	United Nations
WUA	Water Use Associations
UPA	Urban and Peri-urban Agriculture
GMO	Genetically Modified Organism
FIES	Food Insecurity Experience Scale
GLS	Generalized least-squares
MGLM	Multivariate General Linear Model
OLS	Ordinary least squares
PCA	Principal component analysis
KMO	Kaiser-Meyer-Olkin
SEM	Structural Equation Model
RBV	Resource-Based View
ICTs	Information and communication technologies
TPB	Theory of Planned Behaviour
CB-SEM	Covariance-based Structural Equation Modelling
FA	Factor Analysis
CFA	Confirmatory Factor Analysis
HWIAS	Household Water Insecurity Access Scale
DARD	Agriculture and Rural Development
NGOs	Non-Governmental Organizations

Chapter 1: The Problem and Its Setting

1.1 Introduction and Research Problem

Urban farming (UF) has gained support and popularity from around the world in recent years due to the increasing urban populations and the demand for food (Hardman et al., 2022). The COVID-19 pandemic has put urban farming into the spotlight due to the increasing demand for food in urban areas as a result of COVID-19 pandemic restrictions (Nemes et., 2021; Talukder et al., 2021; Murdad et al., 2022). In less developed countries, UF is emerging as a key element to the sustainable development of urban areas, as the Sustainable Development Goal (SDG11) aims to build sustainable cities and communities (Pradhan et al., 2024). According to Fazio (2016) and Sridhar et al (2023), UF has great potential for social, economic, and environmental development through creating employment opportunities, creation of short food supply chains, and biodiversity enhancement. However, access to water and markets hinder entrepreneurial activities and remain key challenges that limit the potential of UF to contribute to the sustainable development of urban areas (Bisaga et al., 2019). Urban-based farmers often face several challenges related to market access and water, which can hinder their growth to becoming successful agricultural entrepreneurs.

Access to markets is important in UF as it determines whether the farmer can generate income from selling their produce. However, many urban farmers face challenges related to market access, such as high transportation costs and limited market opportunities (Specht et al., 2014). The lack of access to markets can result in farmers being unable to sell their produce, leading to discouragement from engaging in agricultural entrepreneurship ventures. Market access and entrepreneurship are key factors for the success of UF. Several studies have investigated the determinants of market access in UF. For example, a study by Negi et al (2018) found that the distance to the markets and the availability of transport to the markets were significant determinants of market access. According to Hunold et al (2017), urban farmers need access to markets for improved profit and sustainable farming enterprise. Furthermore, entrepreneurship or entrepreneurial urban farming is important for improving the ability of urban farmers to be innovative and compete in various markets and improve their livelihoods and food security.

Global food insecurity remains a global challenge, and despite the decrease in prevalence, the ever-increasing population threatens the stability of food systems as the global human population is expected to exceed 9 billion by 2050, which will result in increased stress on attaining food security (Brooks et al., 2013; Rutten., 2013). Climate change, water scarcity, and

socioeconomic inequality further worsened by economic challenges will likely have serious impacts as well (Wheeler & Von Braun., 2013; Fraval et al., 2019). The Food and Agriculture Organization (FAO) estimated that approximately 822 million people were suffering from chronic hunger before the COVID-19 pandemic in 2019 and there is also the uncertainty of the extent of the adverse effects to follow as a result. As a result, people could enter chronic hunger because of the COVID-19 pandemic. Developing countries account for most of them as Africa accounts for about 256 million people who suffer from hunger (FAO., 2020). Furthermore, the Sub-Saharan Africa (SSA) region experienced an increase of approximately 42.9 million people who experienced hunger between 2014 – 2018 (Roser & Ortiz-Ospina., 2013; Haileamlak., 2014; Lomazzi et al., 2014; World Bank Group., 2018). There are also economic challenges coupled with climate change which results in the increase of undernourished people and those who are vulnerable to food insecurity.

The Sustainable Development Goals (SDGs) were developed to achieve a better and more sustainable future for all, where sustainable development goal 2 aims at eradicating hunger and achieving food and nutrition security by 2030 (Liu & Wang 2015; FAO., 2020). However, the rate at which urban growth is occurring has ultimately resulted in the rise of malnutrition cases and unemployment (Eisazadeh et al., 2015). Furthermore, although the COVID-19 pandemic has affected many countries globally, Africa was shown to be the most vulnerable continent as it already has pre-existing economic challenges and crises (Lone & Ahmad., 2020; Zambrano-Monserrate et al., 2020).

According to Bisiga et al (2019), due to unemployment and scarce livelihood opportunities in urban areas, urban dwellers have opted to use their agricultural knowledge to address poverty which has therefore caused UF to expand. UF has attracted attention from researchers because of its ability to generate employment and improve livelihoods (Marsden and Sonnino., 2008). However, a study conducted by Karriem et al (2019) in Cape Town found that the incomes from agricultural activities are not enough for farmers to sustain their families because 90% of the urban farmers' produce is sold within their community and mostly depend on middlemen to access markets outside of the community. Access to markets is a constraint for urban farmers (Houessou et al., 2020), and farmers who are located far away from markets find it difficult to participate in markets because of transportation costs and the market standards for the formal markets include food safety, consistency in food supplies, and environmental management post-production which smallholder farmers in South Africa require training in, (Ngqangweni et al., 2018). According to Ellitan et al (2018), skills training must be integrated, and this will

enable communities to discover their entrepreneurship capabilities that will increase their potential to improve their household welfare.

Research on entrepreneurship in UF is becoming more prevalent in less-developed countries, and social entrepreneurship is gaining traction (Dimitri et al.,2016). However, the concept of farmers becoming entrepreneurs needs a thorough understanding as entrepreneurship is said to be made in two parts. The first part is the managerial skills required to run a profitable farm enterprise; the second part is the 'entrepreneurial spirit" (Kahan., 2013). While urban farmers may possess the skills to be successful farmers, if they lack the spirit of entrepreneurship, they are less than likely to succeed in their endeavors, making these two interrelated for a successful farmer. Furthermore, the UF sector is also a major user of water, it however remains at a more significant disadvantage as water allocation in cities is more directed toward the industrial sector (Haysom., 2015).

In South Africa, drought is becoming a repeated issue that has significant effects on agricultural production (Baudoin et al., 2017). A lack of water has also been shown to be related to poverty as it affects health, energy, and food supply and this would hinder socio-economic development in areas affected by poor water availability (Mancosu et al., 2015). South Africa is categorized as a water-scarce country. The droughts of 2015-2016 showed the severity of this scarcity as Cape Town was ready to implement Day Zero due to the severe drop in the Dam levels (20%) (Millington & Scheba., 2020). Furthermore, the situation is worsened by climate change effects and the impending climate crisis. Furthermore, according to Steyn et al (2019), there is poor water infrastructure in South Africa, making it harder to achieve water security. Water scarcity is not only linked to the amount of water available for use but is also governed by how much of that water is readily available for use. It is therefore important that an investigation of entrepreneurship engagement linked with water access in UF be conducted. Entrepreneurship in agriculture is a complex issue that needs to be studied to understand if urban farmers can be entrepreneurs. Many urban farmers have the entrepreneurial spirit but lack access to resources such as land, water, credit, and access to lucrative markets.

Given the complexity of entrepreneurial engagement, this study investigates the role of market access and water security in agricultural entrepreneurship among urban-based vegetable farmers. The findings of this study can contribute to developing urban policies that provide an enabling environment for urban dwellers to engage in agricultural entrepreneurial engagements to build sustainable livelihoods and improve food and nutrition security.

Unlike many existing studies that focus solely on resource constraints, this study uniquely investigates how improved water access may paradoxically reduce entrepreneurial drive, providing a nuanced empirical contribution to South African urban agriculture literature.

The study pioneers an analytical framework that connects entrepreneurship, water security, and market access through empirical data and Structural Equation Modelling (SEM). It reveals a counterintuitive finding that higher water security may reduce entrepreneurial drive, possibly because reduced resource pressure leads to decreased innovation or risk-taking. The study fills a unique gap by linking the operational (market access, water availability) and psychological (entrepreneurial motivation) components of urban farming. It challenges existing assumptions by showing that access to resources alone is insufficient to drive entrepreneurship behavioural, informational, and institutional factors also matter. This is new ground, particularly in South African urban agri-development literature.

1.2 Justification for the study

South Africa is facing a crisis of high unemployment. The rapid growth of urbanization in South Africa poses a challenge for cities where employment opportunities are scarce, particularly for the youth. The Covid-19 pandemic has further caused a massive global unemployment crisis (Blustein et al., 2020). UF, particularly its value chains offers opportunities for entrepreneurship and job creation in the small and medium enterprise space. According to Sihlobo (2018), there has been a rise in black farmers in recent times, thus indicating that African youth can also enter this sector. However, more efforts are needed to provide farmers with market access opportunities as well as production and institutional support. There is still a gap in knowledge of how market access and water access affect entrepreneurship engagement in UF and the type of relationship these three variables have. The use of water in urban farming is a relevant issue both in terms of competition with other uses and in terms of safety for human health (Lupia & Pulighe., 2015). Therefore, this study will seek to establish if there is any relationship between market access, entrepreneurship engagements, and water security in urban farming, with a focus on water used for irrigation. This study adopted the Theory of Planned Behaviour (TPB) as a foundational lens to understand entrepreneurial engagement in urban farming. It contributes to the literature by combining both operational and psychological aspects of entrepreneurship within the urban farming context. The study will help to identify if urban farmers have the potential to be successful entrepreneurs and how entrepreneurial endeavors can be enhanced to improve urban livelihoods and food and

nutrition security.

1.3 Research objectives

The aim of the study is to establish if there is any relationship between market access, entrepreneurship engagements, and water security in urban farming. The specific research objectives are as follows:

- To identify the determinants of market participation decisions and level of market participation among smallholder urban vegetable farmers.
- To determine the drivers of agricultural entrepreneurship among smallholder urban vegetable farmers.
- To assess the role of water security and market access on entrepreneurship among smallholder urban vegetable farmers.

1.4 Research questions to be answered in the study

- What factors influence smallholder urban vegetable farmers to participate in the market and their market participation level?
- What are the determinants of agricultural entrepreneurship among smallholder urban vegetable farmers?
- What is the role of water security and market access on entrepreneurial engagement in urban farming?

1.5 Structure of the thesis

This thesis is presented in a paper format. The results of the studies are presented in separate manuscript formats that will be submitted to journals for publication. The thesis is divided into an introductory chapter (Chapter 1), a chapter reviewing the literature (Chapter 2), a chapter detailing the methodology and research design (Chapter 3), Chapters presenting empirical findings (Chapter 4,5,6), and a conclusion chapter that summarizes the findings and provides policy recommendations (Chapter 7). Chapter 1 presents the general study background along with a research problem and the objectives of the study. Chapter 2 examines relevant literature on market access, entrepreneurship, and the role of water security in UF. Chapter 3 provides a description of the study areas, the research design, and the type of methods used in collecting and analyzing the data for the study. The determinants of market participation decisions and level of market participation are determined in Chapter 4. Chapters 2 and 5 have been submitted to journals and are under review. Chapter 4 is published. Chapter 5 examines the

drivers of agricultural entrepreneurship among smallholder urban vegetable farmers. Chapter 6 examines the relationship between water security and market access on entrepreneurship. The conclusions and policy recommendations are presented in Chapter 7. A reference list of all the studies referenced in this study is then provided, followed by the annexures.

The following chapter (Chapter 2) provides a literature review for the study.

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Chapter 2: Literature Review

The Role of Water Security in Market access, Entrepreneurship and Food Security in Urban-based Farming

A critical review

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Abstract

The COVID-19 pandemic has caused value chain disruptions that have exposed weaknesses in current urban agri-food systems in less developed countries. Governments in less developed countries have identified the need to support urban smallholder farmers with interventions that can alleviate poverty and positively contribute to household food security. Recent value chain disruptions pose a serious threat to food security and have a negative influence on the participation of urban smallholder farmers in agri-value chains and entrepreneurship activities. It is therefore important to understand if smallholder urban farmers can be successful entrepreneurs who can access markets and participate in lucrative agri-value chains with the prospect of becoming empowered commercialized farmers. The study aims to analyze the state of market access, value chains, urban food systems, and water security in agricultural entrepreneurship through a critical literature review. The articles reviewed were obtained from journals from different subject areas. The results show that agricultural entrepreneurs require, adequate resources, market infrastructure, agency, and entrepreneurial skills to ensure success. Furthermore, in African countries, several constraints hinder the progress of urban farming, and such include planning, cultural attitudes, policy, governance, value chain linkages, and administrative and legal challenges. Access to water is also an important component of urban farming. Furthermore, the concept of food system governance has emerged because of the idea

that food systems should be resilient to cope with environmental and social threats and contribute to food security.

Key words: Water Security, Market access, Entrepreneurship, Food Security, Urban Farming

2.1 Introduction

This chapter is conceptually guided by the Theory of Planned Behaviour (TPB) and the Resource-Based View (RBV) to assess how internal capacity and resource availability shape entrepreneurial behaviour in urban agriculture. In urban areas, water security was previously more human-centric however since the early 1990s, the role of water security in urban farming has received increased attention (Nepal et al., 2021). Nepal et al. (2021) highlight that the Global Water Partnership defines water security as access to affordable safe water at an affordable price whilst ensuring that the natural environment is protected and enhanced. The United Nations (UN) Water (2013) cited in Nepal et al. (2021) has also defined water security as the population's capacity to safeguard access to adequate quantities of safe drinking water to sustain livelihoods, human well-being, and socio- economic development, to ensure against water-borne diseases, water disasters and for preserving ecosystems. The UN Water's definition of water security which includes water security for socio-economic development and livelihood sustenance resonates with the role of water security in urban farming.

Ali et al. (2021) posit that urban farming is a new approach to agriculture that has been acknowledged by the Sustainable Development Agenda as a means to address challenges of food security that had resulted due to a lack of agricultural land from industrialisation and environmental degradation. Zhang et al. (2021) also assert that urban farming is developing a sustainable means to ensure food security and has the capability of improved water retention in comparison to conventional farming. The increased need to ensure food security emanates from more people migrating from rural areas to urban areas in search of better opportunities such as employment and entertainment. According to the United Nations (UN) (2018), urban growth will continue to increase and approximately two-thirds of the world's population will live in cities by 2050. Zainel et al. (2020) highlight that urban population growth is also attributed to social and economic developments in urban areas. Zaniel et al. (2020) in their study in Malaysia also noted the government's justification for urban farming as a consequence of urban farming. Several benefits of urban farming have been listed and these include, food security, food diversification, employment creation, entrepreneurship, the greening of urban spaces and reducing the cost of food for urban dwellers (Muhammed et al., 2020)

Food security refers to access to food physically, socially or economically at all times in

sufficient quantities (Peng & Berry., 2022). Nepal. (2021) like Ali et al. (2021) acknowledge that urban farming has resulted in food security and enabled communities to overcome issues such as increased population that threatened food security. Nepal et al. (2021) opines that there is a food security-energy security-urban farming nexus that results in any change in any one of them affecting the other two. Valley and Witman. (2019) reiterate the interplay between food security and urban farming and note that to ensure the sustainability of urban farming there is a need for planning at the municipal level to provide water and other urban farming inputs. Seigner et al. (2018) in a systematic review of urban farming and food security highlight that urban farming does not always ensure food security in the community. The authors Seigner et al. (2018) illustrate that urban farming is extremely heterogenous and ranges from backyard gardens, rooftop green spaces, urban foraging and commercial urban farms that do make a profit. Due to this heterogeneity in urban farming, Siegner et al. (2018) assert that those that have resources in urban areas are most likely to benefit from food security through urban farming, whilst those living in crowded, low-income areas are least likely to achieve food security from urban farming due to lack of space to farm.

Albeit the heterogeneity of urban farming, the population growth in urban areas is acknowledged by governments and the rapid urban growth forces governments to convert fertile agricultural land into concrete jungles and this is emerging as a key challenge for urban food security and sustainability (Pandey & Seto., 2015; Abass et al., 2018).To address this challenge, Urban farming (UF) has received attention among policymakers and researchers, as a key tool for urban food security and sustainable urban development (Nicholls et al., 2020; Follman et al., 2021). However, the understanding of food security has evolved, and the study of Clapp et al. (2021) has emphasized that agency and sustainability should be recognized in food policy frameworks along with the well-known four dimensions (availability, access, utilization, stability) of food security. Therefore, the new understanding of food security requires that entrepreneurs in agri-value chains can make empowered decisions for long-term planning and farming. UF has the potential to enhance entrepreneurial engagements that strengthen urban agri-value chains and food systems.

The role of UF may be more important for subsistence and income generation given the unfolding impact of the COVID-19 pandemic on agri- value chains, income and food access for the poor and those who have lost job losses. Recent value chain disruptions caused by the COVID-19 pandemic have exposed weaknesses in urban agri-food systems in sub-Saharan Africa. The increasing urban population constantly requires food, and this has led to the

recognition of the contribution of UF in shaping agri-value chains and agri-food systems while

also providing employment and improving livelihoods and household food security. However, it has been found that smallholder farmers do not always possess adequate entrepreneurial skills and knowledge to access markets and be market participants to prospects where they can become sustainable commercial farmers (Louw & Jordaan., 2016; Olivier., 2018; Ndlovu et al., 2021).

Another limiting factor for urban smallholder farming commercial prospects in sub-Saharan Africa is the lack of availability of water for agricultural purposes, whereas in urban settings, water is mostly directed for industrial purposes. According to Rudolph et al. (2021), South African business models should have aspects of socioeconomic development as a foundation, and urban farming objectives should extend beyond those of business profits and include social benefits such as health, nutrition, local economic development, social cohesion, water management and ecological services. Hence, this paper aims to present a review of the literature on the theory and the empirics relating to market access, value chains, entrepreneurship, and the role of water security in urban-based farming. The paper also aims to examine the validity and applicability of the mainstream concept of water security in the context of entrepreneurship and UF.

2.2 Methodology

A total of 80 articles were reviewed, selected using keywords across peer-reviewed databases from 2010–2023. Inclusion criteria included empirical studies on market access, water security, and entrepreneurship in urban contexts. Exclusion criteria involved rural-focused studies and non-English papers. The study employed a critical review to identify relevant and reliable literature on the role of water security; market access; entrepreneurship and food and nutrition security among urban farmers. Given global events that affected food supply chains, even at local and household levels, a critical review was chosen to identify barriers and enablers for urban farmers. To source relevant scientific journals, Google scholar was used and keywords (Urban agriculture, urban food systems, urban food system governance, market access, value chains, water security, entrepreneurship, and food security) were used to search. We scanned the title of the publications and if relevant, read the abstracts to identify if the publication meets the criteria to be included in this review. The criteria included that the articles to be reviewed must be peer-reviewed journal articles and scholarly work that has not been published in a referred journal (e.g. PhD thesis). The studies for selection must have been conducted in urban areas in developed and developing countries.

2.3 Water Security in Urban-based farming

The availability and access to water for urban and peri-urban-based farming is a key factor that affects farmers (Obuobie et al., 2003; Namwata et al., 2015). Access to water is essential for farm production and is crucial for income and profit generation. The urban agriculture sector

is also a major user of water, it however remains at a more significant disadvantage as water allocation in cities is more directed toward the industrial sector (Molle., 2006). UF practises are constrained by water scarcity which is compounded by increasing water demands due to urban expansion and rapid urban population growth (Moglia., 2014).

In urban areas, there are no formal procedures that farmers follow to access water for farming. The farmers often rely on pipe water supplied by the local municipality, rainfall, river, and grey water. Urban farmers use alternative water sources such as wastewater, storm water, and greywater to meet irrigation requirements (Lier & Huibers., 2010; Nnadi et al., 2015). Furthermore, Water is a scarce resource in cities; as a result, urban farmers have therefore opted for other alternatives of water sources to ensure continued livelihoods, these alternatives (untreated wastewater and treated wastewater, dams), however, may present many challenges that can be detrimental to human health and produce safety. Wastewater in cities can be safe when treated for irrigation purposes and can supply some of the nutrients required for crop production (Thomas., 2012).

The issue of water security in urban-based farming should be investigated further in less developed countries because there are studies (Chazovachii., 2012; Mwangi & Crewett., 2019) have argued that irrigators participate more in urban markets, they have more price bargaining power, face shorter value chains and can compete effectively with market intermediaries. Despite the various positive contributions of UF, the water demand cannot be ignored by researchers and policymakers. In a world where fresh water is scarce, particularly in a water-scarce South Africa, efficient water use, water quality and water recycling to meet the demands of urban agriculture need to be explored and detailed.

A lack of water has also been shown to be related to poverty as it affects health, energy, and food supply and this would hinder socioeconomic development in areas affected by poor water availability (Mancosu et al., 2015). Institutions that are there to provide water services are the water boards, which play a crucial role in the water sector, as they operate the dams, bulk water supply infrastructure, some rail infrastructure, and some wastewater plants (Stevens & von Koppen., 2015). The policies in place do not, however, account for the urban farmers, as farmers in rural areas and smallholder farmers are expected to form part of the Water Use Associations (WUA) to be able to be registered and get a license. In South Africa, urban farmers are therefore excluded from the policies addressing water use, access, and quality as there are three water boards: (Rand water in Gauteng Province, Umngeni Water in KwaZulu

Natal, and Overberg Water in the Western Cape). Due to exclusion of urban farmers from these policies, research is needed to understand the effects the exclusion has on their potential for market access and entrepreneurship in their urban-based agricultural practices.

2.4 Water Security in Urban Food Systems

Urban food systems consist of food production, processing, distribution, consumption and the management of waste generated in the process (Nchanji & Bellwood-Howard., 2018). Within the urban food system, there are numerous role players and management of the urban food system is complex. In the food production component of urban food systems, Nchanji and Bellwood-Howard. (2018) note that urban farming is included.

Zainal. (2020) asserts that for urban farming to be successful and ensure urban food security, there has to be social assets in the community and these social assets include material resources such as water security. In turn, understanding and addressing issues of urban food insecurity have resulted in the rise of the need to better understand urban food systems (Battersby., 2013). Defining food systems is important to understand the frame of food systems and how literature conceptualizes food systems. Ericksen. (2008) conceptualizes an urban food system as "a set of activities ranging from production through to consumption", in which such activities include production, processing, packaging, distribution, retailing and consumption. According to Hospes and Brons. (2016), food systems definitions have at least four components that can be notable in these definitions. The first component is activities, which range from food production to consumption. The second component is outcome activities which include outcomes for social welfare, food security and environmental security (Ericksen., 2008; Haysom., 2014; Pereira., 2014). The third component notable in food system definitions is environmental systems and natural resources (Hipel et al., 2010; Herforth et al., 2014). The fourth and final notable component is food-related institutions (Vermeulen et al., 2012). According to Smit. (2016) who cited Ericksen (2008**)**, an urban food system that functions well is one that contributes to food security and sustainable social and economic development.

Urban consumers heavily rely on purchasing food rather than producing it, and therefore urban food security is mostly determined by the affordability factor, as most households with low-income levels have limited access to food varieties (Smit., 2016; de Zeeuw & Prain., 2011). Tong et al. (2020) also note that low-income households' access food through purchasing which consequentially resulted in a lower intake of fresh vegetables and fruits resulting in dietary disorders such as heart disease, obesity and high blood pressure. The study of Tong et al. (2020)

also reveals that previously, interventions to address the issue of poor dietary intake in low-income areas focused on supermarkets, however, this failed as an increase in the number of supermarkets still did not improve health outcomes in low-income areas. In light of this, urban food production focussed more on urban farming to enhance food production. However, in areas where there is a water restriction or lack of water security, food production through urban farming is also negatively impacted. The assertions made by Tong et al. (2020) also resonate with Seigner et al. (2018) who highlight that urban farming requires water security which is not always uniformly provided in urban areas.

The second component of urban food systems as described by Erickson. (2008) includes outcomes for social welfare, food security and environmental security. Urban food system consumers have little knowledge about where their food is produced resulting in unsustainability in the ecological, social, and economic components of food systems (Kirschenmann., 2008; Roggema & Spangenberg., 2015; Vieira et al., 2018). Food security issues must look beyond food availability where existing food systems and value chains must be transformed to achieve economic, social, and environmental sustainability. Zainal et al. (2020) reveal for urban food systems to be successful there is a need for social assets that enhance food security among urban farmers. Zainal. (2020) describes such social assets as the formation of cooperatives that provide social welfare and support for urban farmers. This social support through cooperatives as described by Zainal et al. (2020) includes a system of individuals who are networked and provide support to each other for urban farming. Zainal et al. (2020) also describe the environmental security that is discussed by Erickson (2008) by noting that environmental security will also encompass the security of the physical and social environment. Nepal et al. (2019) also highlight challenges to the second component of urban food systems water security, by noting that environmental security to ensure food security is affected by the topography of the area which makes urban farming difficult even in areas with adequate rainfall. The authors note that irrigation systems may be difficult to support urban farming, especially in mountainous regions. Therefore, with such challenges in the environment, water security for the third component of urban food systems (social welfare, food security and environmental security) to ensure food security in the value chain is unsustainable.

The third component described by (Hipel et al., 2010; Herforth et al., 2014) is the environmental systems and natural resources. Concerning the environmental systems and natural resources (Hopes et al., 2016), the main weakness of the current food systems is the

inability to ensure food security. Climate change is considered a major threat to food systems and food security (Gregory et al., 2005; Agbogidi.,. 2011; Ingram., 2011; Vermeulen et al., 2012; wheeler & Von Braun., 2013; Gitz et al., 2016). The issue of climate change has tasked researchers to question how can food systems cope with climate change which maintains sustainability in food security, biodiversity and human welfare. Finally, several studies convey the problem of food systems in terms of the lack of power for small farmers and consumers (Hendrickson & Heffernan., 2002; Dubuisson-Quellier & Lamine., 2008; Blanc & Kledal., 2012). Eekhout et al. (2018) in their study demonstrated the effect of climate change on water security which affects the urban food system. The authors noted that climate change has resulted in increased precipitation that resulted in the redistribution of water on the surface. This redistribution of water was between water in the soil and water in reservoirs. The authors Eekhout et al. (2018) concluded that the redistribution of water resulted in less water in the soil and more water in water bodies (reservoirs on the surface) coupled with soil erosion resulting in water insecurity. In addition, Ekhout et al. (2018) explain that this redistribution due to climate change necessitated irrigation for urban farming.

The fourth component of the food system is the food-related institutions (Vermeulen et al., 2012). Rahmadanih *et al.* (2018) highlight that food-related institutions include farmer groups that provide support to urban farming to increase food security. The authors assert that farmer groups are particularly useful in negotiating market access for agricultural produce. Furthermore, the farmer groups can facilitate water security and supply of other farming inputs such as seeds. In addition, Rahmadanih *et al.* (2018) note that farmer groups are particularly useful in ensuring household food security through training on food security and nutrition.

The South African government has implemented interventions to address urban food insecurity, but most interventions have been ineffective because they have focused on UF in isolation and have not considered that UF is a part of a wider complex food system (Battersby et al., 2015). Over recent years, South Africa's agricultural policies have been designed to satisfy and compete in global markets, and therefore, the agricultural sector is strongly shaped by the corporate agri-food system (Greenberg., 2010; Siebert., 2020). Since the early 1990s, smallholder suppliers have been marginalized due to the formalization of the food supply chain and supermarket expansion (Du Toit & Neves., 2014; Peyton & Battersby., 2015). The conversion to more formalized food supply chains has resulted in producers and suppliers having to change the way food is produced, processed, and distributed.

2.4.1 Food system governance

Several studies (Schiff., 2008; Rocha & Lessa., 2009; Clark., 2010; FAO., 2011; MacRae., 2011; Mansfield & Mendes., 2012; Blay-Palmer et al., 2013; Fridman & Lenters., 2013; Sonnino., 2013; Clancy., 2014; Forster & Esceduro., 2014; Haysom., 2014) highlight food policy and describe alternative food systems and the governing of local food systems by joint efforts of citizens, civil society organizations and municipality governments. There is a wide range of actors involved in governance, such are government organisations, non-government organisations (NGOs), political parties, community groups and traditional leaders (Devas., 2001; Battersby & Watson., 2018). However, Tong et al. (2020) note that despite the contribution of the various role players in urban agriculture, food security remains a challenge due to a lack of municipal departments dedicated to urban farming water management. This in turn means that water security management without the incorporation of urban farming participants may not be comprehensive to address the needs of urban farming. As such without adequate water security market access can be poor & unsustainable and thus negative for entrepreneurship.

Nchanji and Bellwood-Howard. (2018) describe the governance of urban food systems in Ghana by revealing that urban food systems are complex and are governed by different players at different components and sometimes with overlapping roles. Nchanji and Bellwood-Howard. (2018) further explain that governance of urban food systems is done by both individuals and institutions and because of the complexity of the roles, there is the ambiguity in rules and norms that govern the components of food systems. As a result of the complexity of governing urban food systems, and the ambiguous rules, Nchanji and Bellwood-Howard. (2018) also assert that there is a lot of exploitation of key role players in urban food systems. In Ethiopia, Mohammed et al. (2020) like Tong et al. (2020) note that the lack of a dedicated department at the municipal level to provide governance to urban farming results in poor governance. Notably, the lack of governance, or the exploitative nature of governance for food systems described by Tong et al. (2020); Nchanji and Bellwood-Howard. (2020) resonates with the definition of poor governance in Africa illustrated by Mohammed et al. (2020) who notes that poor governance in any system in Africa is characterised by corruption and exploitation.

In the United States of America, the issue of governance of urban food systems is also discussed by Carolan. (2019), the author notes that the inclusion of digital platforms in the governance of food systems including urban farming has facilitated governance. In addition, Carolan. (2019) also adds that digitisation has removed barriers that promote inequity by

providing linkages with various role players such as urban planners, farmers, marketers and consumers. Also, in the United States of America, Piso et al. (2019) acknowledge that there are several role players in urban food systems and each of these role players has different purposes for governance in food systems. Piso et al. (2019) single out the urban farming stewards who value environmental sustainability in urban farming and place emphasis on the environmental water security and sustainability of food production. Piso et al. (2019) like Nchanji and Bellwood-Howard, (2018) note that the different stakeholders in the governance of urban food systems result in a lot of stakeholders in the governance of the food systems. As a result, Piso et al. (2019) note that governance in urban food systems results in different values due to diversity.

The governance mechanisms of these actors in terms of policies and legal frameworks must consider food security challenges and food system sustainability. South Africa has no urban-specific food policies, and this implies that there are no mechanisms to allocate financial resources to structures other than national or provincial government to resource systemic programmes aimed at addressing urban or local scale food system challenges (Haysom., 2015). This is even though their policies and legal frameworks consider food security challenges, and such make it a necessity for city governments to act. There are large private organizations such as multinational food companies that play an important role in the governance of urban food systems (Smit., 2016). However, the existence of these organizations can hinder informal traders from participating in markets. The informal sector is important because most small producers operate in this sector, thus informal business organizations can also play an important role in urban food system governance. In Africa, markets are an important element of urban food systems and are an important site for urban governance (Smit., 2018). The governance of marketplaces can impact the accessibility quality and prices of food, and market associations play a significant role to manage market places and addressing market constraints in Africa (Porter et el., 2007; Smit., 2016).

More research is needed to unpack and understand the need for urban food governance in urban areas of Africa, and to identify what actions are required to address wider food system changes and constraints. Furthermore, the weakness of urban food system governance needs to be further studied. Studies have highlighted that food policy is fragmented since food issues are dispersed over different policy domains such as agriculture, health and society (Hopes and Brons., 2016; Termeer et al., 2018), Urban food system governance can fail to join perspectives and priorities of urban populations with those rural population (Thompson & Scoones., 2009;

Barungi., 2013). In addition, there exists multi-governance where the decision-making power is across levels and this poses a key issue and risk as some decisions may be politically influenced which is the case in most African countries.

2.5 Urban Farming (UF)

Urban Farming forms part of the food production component of urban food systems. (Nchanji and Bellwood-Howard., 2018). Yusoff, et al. (2017) define urban farming as the production of food or livestock for income generation in urban areas or areas surrounding urban areas. In addition, Yusoff et al. (2017) cite Watson. (2015) who defines urban farming as the raising of plants and livestock in urban areas either in allotment land or unoccupied spaces. Yusoff et al. (2017) further identify three types of urban farming, which include vertical farming, rooftop farming and community farming. The different types of urban farming have the same purposes and practices but with different space organisations and boundaries (Yusuf et al., 2017). Grebitus et al. (2020) make a distinction between urban farming and farming in rural areas by noting that urban farming is more focused on producing food for consumption in comparison to rural farming which may produce a commercial crop for industrial use. The authors Grebitus et al. (2020) further note that most food produced through urban farming includes fruits and vegetables that are readily available at farmers' markets. The benefits of urban farming include food security, improved economic resilience, social improvement and environmental stewardship (Yusoff et al., 2017). Notably, with regard to environmental stewardship, Yusoff et al. (2017) note that urban farming reduces wastewater management resulting in water security. Similarly, Sasamita et al. (2020) also outline that urban farming enables productive usage of wastewater contributing to water security in urban areas.

2.5.1 Contribution of UF to sustainable cities and communities

Population growth in cities and towns is currently a challenge faced globally. By 2050, about two-thirds of the world's population will live in cities, and most future urban growth will occur in the Global South (Desa., 2018). Rapid urbanisation is currently threatening the sustainability of agriculture in urban areas (Amponsah et al., 2015; Liu et al., 2017), as rapid urban expansion results in the conversion of fertile agricultural land into built-up urban areas, which is a key threat to urban food security and sustainability (Pandey & Seto., 2015; Zommers et al., 2017; Abass et al., 2018). Several studies (Pearson et al., 2010; Ferreira et al., 2018; Azunre et al., 2019; Skar et al., 2020) have established the contribution of UF to resilient and sustainable cities. UFis defined as the production of crop and livestock goods within cities and towns (Zezza & Tasciotti., 2010). The Food and Agriculture Organisation of the United Nations

(FAO) also introduced the acronym UPA (Urban and Peri-urban Agriculture), where peri-urban agriculture is practised in the surrounding areas of cities.

It has been claimed that the social and environmental impacts of UF make a significant contribution to urban sustainability (Lovel, 2010; Surls et al., 2015). Social impacts include human health benefits (physical and mental), community development, and educational benefits. UF is also credited with positive environmental impacts such as greening cities (Tan et al., 2017; Van Tuijl et al., 2018), boosting biodiversity (Ghezeljeh., 2020; Heath et al., 2020), and improving natural resource efficiency. UF also contributes to an improved urban environment in other ways. One of the most efficient ways of improving the environment is through recycling organic waste. Compost from urban organics can easily be applied in urban and peri-urban plots and serve as fertilizer.

In less developed countries, rapid urbanization results in increasing unemployment, increased urban poverty, a polluted environment, and increased food insecurity, however, UF presents opportunities for improving the local economy, food supply, health conditions and environmental sustainability (Orsini et al., 2013). The sustainable city concept has gained attention in recent times because it is evident in the Sustainable Development Goal [SDG] 11, which is "to make cities and human settlements inclusive, safe, resilient and sustainable. UF can contribute to the sustainability of a city by improvements to the economic, social, and environmental factors of a city (Azunre et al.,2019). There are several urban farms in cities like Durban, Pretoria, and Cape Town that produce commodities that are sold at the local markets. These commodities play a role in the food systems in Cape Flats and Durban communities as they are the most affordable staples rich in nutrients and allow for diverse diets at household levels (Sonday., 2014). The growth of UPA through the production, processing, packaging, and marketing of consumables, thus increasing entrepreneurial activity while also creating job opportunities which increase household income and improve access to food for urban dwellers thus alleviating the occurrence of chronic hunger and food insecurity (Nugent., 2000; Kahan., 2013).

2.5.2 Contribution of UF to Food & Nutrition Security

Urban farming, food and nutrition security are interconnected through the contribution of urban farming to food nutrition and security (Yusoof et al., 2018). Yusoff et al. (2018) highlight that one of the contributions of Urban farming is health and security. In their discussion, Yusoff et al. (2017) describe the health and nutrition that urban farming contributes to inclusive of access

to food and nutrition, enabling availability of fruit and vegetables, nutrient retention, therapeutic treatment, and enabling physical exercise. Grebitus et al. (2020) note that sustainable urban farming contributes to the sustainability of society, the environment and the economy. In their description, the authors Grebitus et al. (2020) explain that urban farming contributes to the environment by ensuring green spaces in urban areas that mitigate carbon emissions and reduce the effects of climate change. The Food and Agricultural Organisation (FAO) (2022) highlights that environmental sustainability means that the food value system has a positive or neutral impact on the environment. Through income generation, as defined by Yusoff et al. (2017) urban farming sustains food security by enabling income generation. FAO. (2022) also notes that sustainable food value chains should encompass economic sustainability by ensuring that the value chain is profitable throughout the processes. Concerning social sustainability FAO. (2022) also adds that social sustainability entails

Value chain participation entails role players who procure food and add value to them and sell them to the next level (FAO., 2022). According to FAO. (2022), the role players carry out four primary functions which include: food production, through farming, fisheries, harvesting or agroforestry; aggregation through the collection and storing of food; the third function the processing and the last function is distribution. In South Africa, with regard to value chain participation in a study conducted in KwaZulu-Natal, it was concluded that value chain participation contributes to food security among smallholder farmers who participated in value chain participation (Ndlovu et al., 2021). The study in KwaZulu-Natal also found that in addition, to value chain participation farmers who were more food secure had water security (Ndlovu et al., 2021). The author Ndlovu et al. (2021) further asserted that coordination in value chain participation was influenced by challenges such as water insecurity, lack of infrastructure, infertile soils and lack of agricultural inputs.

Food and nutrition security issues have implications for people dwelling in low and middle-income countries, and UF has been identified as a solution to the food crises faced by the growing urban populations (Stewart et al., 2013). Based on case study reviews, there is an agreement that the direct food security purpose exists, however, there is a great number of urban farmers who also produce to sell on the market, especially in Latin America than in Africa (Maxwell., 2003; Zezza & Tasciotti., 2010). UF has an impact on urban food security in several ways. At the household level, UF can be a source of income, can provide direct access to a larger number of nutritionally rich foods (vegetables, fruit, meat) and a more varied diet,

can increase the stability of household food consumption against seasonality or other temporary shortages (Armar-klemesu., 2000; Maxwell., 2003).

The urban poor responds to inadequate access to food and the lack of purchasing power by engaging in UF as a strategy to increase food access and availability at the household level, thus ensuring food security (Korir et al., 2015). UF presents opportunities for urban dwellers to grow food where they reside which increases food availability and therefore hunger, poverty and malnutrition can be prevented. According to Mougeot. (2005), UF uses two main pathways to improve food security: improved access to food and increased income. In addition, Opitz et al. (2016) argue that two different paths must be pursued to improve the impact of UF on urban food security, and those paths are increasing the number of economically motivated professionals in UF and increasing the production of fresh food at the household level to supplement dietary requirements.

The COVID-19 pandemic has resulted in disruption in the food supply chain, increased food waste because of shortages of labour and magnified physical and economic constraints that restrict food, and this has worsened food insecurity in urban areas (Lal., 2020; Abid & Jie., 2021; Balkan et al., 2021; Barman et al., 2021; Abu Hatab et al., 2021). Therefore, the effects COVID-19 pandemic on food security has motivated the need to adopt more resilient urban food systems to boost local food production to meet food needs. UF can play a more critical role in eradicating food insecurity caused by a global pandemic such as COVID-19. In the recent decade, rising food and fuel prices have also threatened the food security status of the urban poor but practising UF has enabled the urban poor to gain access to food during times of distress (Gallaher et al., 2013).

In developing countries like South Africa, UF plays a significant role in social and individual benefits which may, in turn, supersede food security and economic benefits (Battesrby et al., 2015). Less-developed countries may see urban agriculture to create sustainable economies and address food security. For developed countries, UF is to create green spaces, feed the cities poor, and for health reasons (eating free-range products and GMO (Genetically Modified Organism) free foods) (Van Tujil et al., 2018). Gender also plays a role in UF, for example, in the case of Msunduzi local municipality in South Africa, women dominate UF and investment in women will significantly enhance the food security status of urban households (Mudhara et al., 2014)

2.5.3 Problems and Constraints in UF

The benefits of UF on the local economy, communities, food security and environment are well established in the literature. Despite the positive contribution of UF, there are established problems and constraints faced by farmers and local communities due to practicing UF. UF has been identified to cause a health hazard and multiple problems can occur when solid waste is processed, or wastewater is used for irrigation (Keraita et al., 2002; Martijn et al., 2005; Rutkowski et al.,2007; Qadir et al., 2010). Poor management of compost piles can increase diseases such as bronchitis, tuberculosis, dysentery, and cancer caused by waste gases (Bryld., 2003). The use of chemical fertilizers in farming also poses potential human health and environmental problems because the chemicals can affect soil and water quality in urban areas. Appropriate farming practices can lead to soil erosion, destruction of vegetation and depletion of water resources in urban environments (Mougeot., 2000; Dastorani et al., 2008). Other studies underscored the intensifying climate risks as a significant concern for urban production activities in developing countries, owing to social and environmental stresses such as rapid population growth, systemic poverty, and poor governance (Lwasa et al., 2014; Revi et al., 2014). Furthermore, another major daily problem experienced by urban farmers is theft (May & Rogerson., 1995; Mbonganie-Mwangie & Foeken., 1996; Bryld., 2003; Eriksen-Hamel & Danso., 2010). Urban farmers occasionally deal with the loss of crops or livestock which makes urban farming a high risk.

A major constraint in UF is access to land and water to conduct agricultural practices. Urban farmers lack secure tenure and the lack of land and insecure tenure often prohibit farming and investments in urban agricultural ventures (Malan., 2015; Namwata et al., 2015; Suchá et al., 2020). As a result, some urban farmers have opted for indoor farming, vertical farming, and planting using sacks. However, Frayne et al. (2014) argue that access to land is a necessary precondition of UF to successfully improve urban food security. Infrastructural constraints include the lack of facilities for processing, storage, labour-saving technologies, and poor market infrastructure (Olumba et al., 2021). There are important factors that have been identified as key in constraining UF in urban areas.

Institutional constraints are also established in UF, where there are inefficient extension delivery systems, poor UF governance, poor access to credit and land-grabbing issues (Olumba et al., 2021). Urban areas have also been found to have weak extension service delivery which affects farmers because they have inadequate farming and market information. Furthermore, the credit constraints among urban farmers imply that they are unable to access capital to

purchase land, agricultural inputs and higher labour to work on their farms, thus scaling production is a key challenge.

2.6 Market Access & Value Chain participation in urban-based farming.

Water security has been identified as one of the parameters to improve the resilience of urban food systems (Vroegindewey & Hodbod., 2018). Vroegindewey and Hodbod. (2018) illustrate that in urban food systems, the resilience in food value chain chains has become critical due to rapid industrialisation and climate change which impact water security resulting in disturbances in food systems that ultimately impact human livelihoods. In addition to changes in water security due to climate change and industrialisation, farmers who are in urban and peri-urban areas are close to extensive metropolitan markets and trading centres, yet they still find it difficult to secure markets to sell their agricultural products (Opitz et al., 2016; Kolaj et al., 2019). Access to markets is a constraint for urban farmers (Nyapendi et al., 2010; Akinlade et al., 2013; Houessou et al., 2020), and farmers who are located far away from markets find it difficult to participate in markets because of transportation costs. This challenge of lack of access to markets by urban farmers negates the advantages of urban farming asserted by Yusoff et al. (2017) who note that urban farming reduces food mileage enabling access to food by consumers in urban areas.

In addition, there is a lack of cooperation among urban farmers resulting in weak bargaining power. A study conducted by Karriem et al. (2019) in Cape Town South Africa, found that approximately 90% of the urban-based farmers produce to sell within their own communities and close businesses, and mostly depend on middlemen to access markets outside of the community. Supplying high-value markets such as supermarkets can offer higher incomes for smallholder farmers but commercial linkages and accessing these markets requires an upgrade in skills, product quality or quantity and competence in managing a sustainable business (Kaganzi et al., 2007; Hellin et al., 2009; Kaganzi et al., 2009; Markelova et al., 2009; Ferris et al., 2014; Royer et al., 2016). Similarly in Ethiopia, Usman and Callo-Concha. (2021) highlight that smallholder farmers have challenges in accessing markets which affects their ability to earn an income. In light of this, Usman and Callo-Concha. (2021) also indicate that the diminished income as a consequence of lack of access to Markets results in low dietary diversification at the household level affecting food security at the household level.

Commercialization entails market orientation and value chain participation, which enhances the linkages between the input and output sides of agricultural markets (Gebremedhin., 2010;

Gebremedhin & Jaleta., 2010). Some studies have identified a positive relationship between market orientation and commercialization among rural farmers (Kim et al., 2016; Martey et al., 2017; Koye et al., 2021). Furthermore, Gebremedhin and Tegegne. (2012) found that market access and production factors affect market orientation, while market access and volume of production affect market participation.

More Research is still necessary to establish if there is a positive relationship between value chain participation and commercialization among urban-based farmers in less developed countries. Value chain participation is critical for improving incomes, particularly for low-income households (Ndlovu et al., 2021). However, farmer participation remains low in domestic and regional value chains in Africa because of various constraints. In developed countries such as the United States of America, Tong et al. (2020) present a different scenario based on the diversity of urban farming. The authors, Tong et al. (2020) note that among small-scale urban farmers, there is a practice of food sharing which improves collaboration among farmers to enable access to markets and improvement in food diversification.

Previous attempts to improve value chain participation and access to markets for smallholder farmers through market reforms have been mainly ineffective (Akinlade et al., 2016). These market reforms are to improve the functioning of markets by increasing competition among producers. Despite those efforts, smallholder farmers still sell at markets that are characterized by low volumes, low activity, and non-competitiveness (Obare et al., 2006). Enhancing market access for smallholder urban-based farmers using market reforms and farmer support programmes needs further investigation. Several studies (Hellin et al., 2009; Markelova et al., 2009; Markelova et al., 2010; Shiferaw et al., 2011) have established that farmer organizations and collective action are effective in enhancing access to the market for farmers.

Access to markets also improves the ability of farmers to attain food diversity (Boneudi et al., 2022). Bonuedi et al. (2022) note that farmers in urban areas that depend on seasonal rainfall for agricultural production are also affected by a lack of access to markets which impacts their value chain participation. The authors Bonuedi et al. (2022) affirm that water insecurity as a result of seasonal rainfall results in farmers failing to access food diversity. As a result, the authors posit that it is only farmers who access markets who attain food diversity during lean seasons. In their recommendations, Bonuedi et al. (2022) note that access to markets can be improved through improved

Given the reality of market structures in developing countries, measures to improve market access must be combined with those of smallholder productivity growth (Alene et al., 2008; Fischer & Qaim., 2012) because productivity growth alone is insufficient to address market access challenges faced by small farmers (Jagwe et al., 2010; Obi., 2011). Farmers in urban areas are faced with poor value chain linkages and inaccessible markets because of socio-economic, institutional, and infrastructural constraints, and it is key to assess and address these constraints in addition to farm productivity growth. High productivity provides marketable surpluses for smallholder farmers, but it does not necessarily mean the surplus will meet the market standards and requirements.

Smallholder farmers are often excluded from formal fresh produce markets because the market standards include food safety, consistent quality and quantity, good agricultural practises (GAP), and appropriate post-harvest handling and storage in which farmers still require training (Narrod et al., 2009; Louw & Jordaan., 2016; Ngqangweni et al., 2018). The lack of supporting services decreases some of the farmers' incentives to participate in markets, especially in South Africa where unemployed people are always relying on government support. Furthermore, these challenges, combined with a lack of cash, resources, and market information further weaken farmers' position along the value chain (Ndlovu et al., 2021). Bonuedi et al. (2022) also note that in rural areas, access to markets is also hindered by inaccessible roads and distance to these markets where transporting farm produce to markets may not be profitable for farmers. Many studies investigate how to unlock markets for smallholder farmers who are located in rural areas, but more studies are necessary to understand smallholder farmer value chain participation decisions and unlock market access for urban-based farmers.

Some studies (Shiferaw & Murich., 2011; Murugani & Thamaga-Chitja., 2018; Nikam et al., 2019) have highlighted that institutions can enhance or inhibit smallholder farmers' market access and development. Farmers need market training and exposure to take advantage of the new and existing value chain and market opportunities, however, in the case of South Africa, there is a restricted emphasis on training for issues of marketing failure to attach with new policies aimed to improve smallholder farmers' potential to commercialize (Murugani & Thamaga-Chitja., 2018). Most of the smallholder farmers rely on selling at the farm gate, suggesting that they lack the agency that can empower them to access and participate in high-value levels within the value chain. Research is needed to investigate how urban-based farmers can be empowered to pursue formal markets using education and training. The role of

improving human capital for improved value chain participation and improved market access needs further investigation, especially in less developed countries.

2.7 Entrepreneurship in Urban Farming

Despite many studies that have researched entrepreneurship, many studies have neglected agricultural entrepreneurship, however, in recent years, studies in several countries have identified and evaluated entrepreneurial opportunities in the agricultural sector (Dias et al., 2019; Lans et al., 2020). The increase in acknowledgement of entrepreneurship in the agricultural sector has been driven by that the sector has now become one of the largest that contributes to employment and improved livelihoods.

Tsyplakova et al. (2020) contend that UF is a form of entrepreneurship that has created employment in urban areas. The authors further note that for UF to be profitable there is a need for innovation and the use of technology in the business. The authors, Tsyplakova et al. (2020 note that the need for innovation in urban farming has been necessitated by a lack of land for farming purposes in urban areas. Tsyplakova et al. (2020) give an example of the use of old derelict factory buildings for urban farming as an innovative way of urban farming entrepreneurship that mitigates the challenges of land. The authors note that such practices have ensured water security by reducing consumption by 10% through the use of water in a closed circuit. Arief et al. (2021) also agree on the need for innovation in urban farming as a form of entrepreneurship by noting the use of hydroponic farming systems. Such innovations in farming described by Tsyplakova et al. (2020) are entrepreneurial as they reduce costs of food production which are supported by the ease of market access through shortened distance to markets in comparison to rural farmers. Jassem and Razzak. (2020) also outline the entrepreneurial opportunity presented by urban farming, especially hydroponic farming. The authors Jassem, and Razzak. (2020) give an example of the Green Spirit Farms in New York which have used vertical farming with the use of old derelict factories, also overcoming the unavailability of land in urban areas for farming purposes. These farms have made use of hydroponic farming, which uses water with suitable nutrient components for each plant grown as a base for the roots. This water is computer-monitored and recycled periodically (Jassem, and Razzak., 2020). The Green Spirit Farms described by Jassem, and Razzak. (2020) only grow organic vegetables which include tomatoes, brussels sprouts, kale and green pepper.

Despite the success of urban farms as a means of ensuring entrepreneurship, Jassem, and Razzak. (2020) note that there are challenges that urban farming entrepreneurs face. These

include large capital requirements to set up hydroponic systems, the cost of leasing or buying land for farming purposes and the additional costs of ensuring water and energy access, especially when farming is to be done on disused land. Exacerbating the capital challenges, Jassem, and Razzak. (2020) also reveal that banks are reluctant to finance urban farming.

The innovation and skills necessary for successful urban farming also require training and skills development. Jassem and Razzak. (2020) highlight that this need for training and skills development is also a challenge for urban farming entrepreneurs. Arief et al. (2021) also agree with Jassem and Razzak. (2020) and highlight that urban farming requires innovation, however, Arief et al. (2021) do not share a similar opinion that the need for innovation is a challenge for the urban farmer. The authors, Arief et al. (2021) note that providing training on new innovations in urban farming is also a form of entrepreneurship for the urban farmer.

Despite the need for innovation, large capital amounts and continued training, the agricultural sector today employs over one thousand million people, while contributing to 3% of the global Gross Domestic Product (FAO, 2016; Fitzkoch et al., 2018). Nonetheless, according to Pindado and Sánchez. (2017) defining agricultural entrepreneurship is still a matter of discussion among researchers because it has been associated with the development of non-agricultural businesses driven by farmers, and it has also been linked with developing new agricultural outputs, innovative business methodologies, distribution, and marketing. Furthermore, according to Richards and Bulkley. (2007), agricultural entrepreneurs organize all activities that enable the farmers to change a free market economy to an entrepreneurial one. Notable, a very important aspect of agricultural entrepreneurship is the entrepreneurial strategies and management strategies such as specialization, diversification and supplementation implemented by agricultural businesses to respond to structural changes in the agriculture industry (Abdullah & Sulaiman., 2013).

Agricultural businesses constantly must adapt to structural changes such as market changes, changes in consumer behaviour and changes in food safety and quality standards in the agricultural sector. Farmers face many challenges because of the rapid changes in agriculture, therefore entrepreneurial skills are important for success. The study of Dias et al. (2019) analysed agricultural entrepreneurship through a systematic literature review and their findings narrowed it down to three main thematic approaches when discussing entrepreneurship in urban-based agriculture. These thematic approaches are (i) entrepreneurial skills and behaviour, (ii) entrepreneurial activity, and (iii) entrepreneurial strategies.

2.7.1 Entrepreneurial skills

According to Seuneke et al. (2013) and Dias et al .(2019), the existing literature on agricultural entrepreneurship is focused on understanding farmers' entrepreneurial skills and behaviour. Several studies have argued that entrepreneurship is not an occupation, but rather has to do with the attitudes and behaviours of people (Wennekers & Thurik., 1999; Fatolle & Degeorge., 2006; Kusmintarti et al., 2014). It is therefore important that during the development of entrepreneurial skills for successful agricultural entrepreneurship that there is a concurrent assessment of farmer attitudes and behaviours towards entrepreneurship. Some studies have highlighted that the entrepreneurial skill set of agricultural entrepreneurs is lower when compared to entrepreneurs in other sectors (Miguel & Hamory, 2009; Beegle et al., 2011). According to Pindado and Sánchez. (2017), several studies concluded that farmers who diversify their activities do possess entrepreneurial skills which directly determine their entrepreneurial behaviour. Entrepreneurial skills development needs more emphasis on education and training programs intending to develop the human capital of farmers.

According to Rae. (2010), education is important for developing entrepreneurial skills and it outlines the requirements needed by an individual or collective to be a successful entrepreneur. Educated individuals have dynamic behaviours and motivation and the probability of achieving success in entrepreneurship in the agricultural sector is higher (Guzman & Javier Santos., 2001; Gurjar et al., 2017; Salau et al., 2017; Zaca et al., 2021), however, education has a negative influence on the decision of individuals to become an agricultural entrepreneur comparing with other economic sectors (Pindado & Sánchez., 2017). More research is required to explain the significance of training programs, education, and empowerment programs in building entrepreneurial skills. Many smallholder farmers do not have sufficient entrepreneurial skills, market information or business networks to succeed as agricultural entrepreneurs (Grande et al., 2011). Urban farmers, are often smallholders and would experience the same constraints. Therefore, further investigations are required on education and training through agricultural entrepreneurship programs because entrepreneurial skills and behaviours are determined more by education than age and gender in farming operations (Rosairo & Potts., 2016).

The age and gender of farmers is an important component of investigation for assessing entrepreneurial behaviour and skills. In less developed countries, women play an important role in family farming, but men are more involved in entrepreneurship in agriculture (Pindado & Sánchez., 2017). According to Welter. (2011), there are more barriers to entrepreneurship for women in less developed countries. Gurjar et al (2017) and Singh et al. (2013) found a

significant and positive relationship between market orientation and the entrepreneurial behaviour of farmers and therefore, women entrepreneurs require marketing training in sub-Saharan Africa (Amin & Staub., 2009).

According to Morris et al. (2017), older farmers are reluctant to change, and they are less likely to adopt new technology and farming methods. Younger people are more inquisitive about education and are more productive, however, younger people are drawn to other economic sectors and are less likely to become entrepreneurs in the farming sector (Pindado & Sánchez., 2017; Ridha & Wahyu., 2017). Therefore, in less developed countries, there is a need for education and training targeting the youth to encourage them to be involved in agribusiness and develop their entrepreneurial skills (Mohamed et al., 2012; Yami et al., 2019; Ogunmodede et al., 2020). Education and training positively affect entrepreneurial behaviour in the agricultural sector, but it is essential to note that training requirements differ across different agricultural subsectors and between men and women (Dias et al., 2021).

2.7.2 Water Security to support Urban Farming Entrepreneurial activity

Water security remains a critical factor in the success of urban farming (Tone et al., 2020). Agricultural entrepreneurial activity depends on land as a production factor and land use activities have a direct impact on the environment, which local farmers do not consider the impacts of their farming activities on the environment (Britz et al., 2012; Pindado and Sánchez., 2017). Urban farming activities can lead to soil and water contamination and public health may also be affected because of continuous exposure to various pollutants (Wortman & Lovel, 2013; Igalavithana et al., 2017; Manikas et al., 2020). This contamination of soil and water in turn impacts the water security that is required for sustainable urban farming.

According to Igalavithana et al. (2017), using organic fertilizers instead of inorganic fertilizers is a long-term solution for better health and security of urban farming. In recent years, organic farming has gained attention and increased because it is oriented to market niches and has been found to play an important role in promoting biodiversity and sustainable agriculture (D'Oronzio & Pascarelli., 2016; Anzaku & Salau.,2017). Agricultural entrepreneurs must adapt to the challenges of climate change (Kangogo et al., 2020), consumer behaviour and food safety (Lans et al., 2020), which often leads to instability of agricultural markets. Therefore, more studies must be conducted to fully assess and understand how organic farming activities can help farmers to adapt to such challenges and enable them to grow their farm entrepreneurial activities.

The availability of land and other resources for entrepreneurial activities is usually a constraint in urban areas, in which namely the relatively small portions of urban farms places, high land costs, water prices and regulatory barriers (Oberholtzer et al., 2014). Urban farming activities are usually on public and institutional land owned by municipalities (Delgado., 2017), and land is not generally available for purchase from community landowners and renting is often the common option. The new strategic focus should aim to boost smallholder entrepreneurial drive and activity by providing secure land use rights, access to market information and affordable irrigation systems (Cele & Wale., 2020).

2.7.3 Entrepreneurial strategies

Agricultural entrepreneurs choose different strategies to adopt based on their agricultural business, diversification practices product type and size, innovation, and available marketing channels (Dias et al., 2010). According to Hassink et al. (2016), the topic of entrepreneurial strategies has gained more interest from researchers because of changing demands of society which has opened new opportunities and diversification strategies among farmers. Diversification is an entrepreneurial strategy that has been adopted by farmers in recent years. To maximize the multi-functionality of farms, entrepreneurial or farm diversification is important (Yoshida et al., 2019), and diversification improves the probability of operating a successful farm enterprise (Methorst et al., 2016). Furthermore, farmers in less developed countries with no formal training acknowledge that they need to become more entrepreneurial and develop crop diversification because such strategies manage risks and crop losses (Di Falco & Perrings., 2005).

Urban farmers have adopted various innovative strategies to overcome barriers to land in urban farming. These strategies include hydroponic farming, aeroponics and vertical farming (Muhammed et al., 2020). Muhammed et al. (2020) further note that such strategies have resulted in the production of fresh vegetables that not only reduced the costs at the household level but also facilitated entrepreneurship.

Other strategies include processing fresh products to develop new products such as sweets, juice or liquors which makes it essential to also brand the products. Agricultural entrepreneurs also use alternative food networks such as farmers' markets and direct sales which these networks have positive effects on small-medium size enterprises (Tudisca et al., 2014; Darolt et al., 2016). Furthermore, Alternative food networks are important because they enable small

farm enterprises to sell through short supply chains by eliminating the middleman (Tudisca et al., 2014; Forssell & Lankoski., 2015).

The entrepreneurial strategy-making process that entrepreneurs use to create a competitive advantage is examined using entrepreneurial orientation (Gupta & Pandit., 2012; Zeebaree & Siron., 2017). Entrepreneurial Orientation is a strategic orientation that reflects the entrepreneurial strategy-making process and literature about entrepreneurship has raised the importance of this issue (Rauch et al., 2009). Several empirical studies have highlighted the positive contribution of entrepreneurial orientation on innovation capability (Fahim & Rohaizat., 2017), absorptive capacity (Gellynck et al., 2015), and product and marketing innovation (Micheels & Boeker., 2017). However, more research must be conducted to have a better understanding of entrepreneurial orientation in the agricultural sector. More research is also needed to explore entrepreneurial strategies in less developed countries, and it is important to understand under what circumstances or which type of farming can increase entrepreneurial orientation and lead to improved performance (Veidal & Flaten., 2014). It is necessary to understand if increased entrepreneurial orientation can lead to increased performance in urban-based farming and examining the factors that are significant in urban farmers' activities and strategies is also necessary. Furthermore, Strategies aiming to instil entrepreneurship in smallholder behaviour must recognise that it is possible to be a survival or subsistence entrepreneur without necessarily maximising profit, as this will gradually enable them to add value in the market by taking advantage of opportunities when they arise (Wale & Chipfuba., 2021).

2.8 Chapter Summary

This study proposes an integrated conceptual model that links the key constructs of entrepreneurship, market access, water security, and food system governance within the framework of urban farming systems. At the core of this model is the recognition that entrepreneurial engagement among smallholder urban farmers is influenced by both structural resources (e.g., access to water and markets) and institutional support systems (e.g., food governance frameworks, extension services, and cooperatives). Water security is not only a production input but also a determinant of perceived risk and motivation, potentially shaping entrepreneurial behavior. Market access, on the other hand, serves as both an incentive and a constraint for entrepreneurial decision-making. The model also positions food system governance as the enabling (or limiting) environment that mediates these relationships by either facilitating or hindering resource distribution, policy coherence, and institutional support.

Together, these interconnected dimensions illustrate how urban-based entrepreneurial farming is shaped by a combination of resource-based, behavioral, and institutional factors—thus aligning with the Theory of Planned Behaviour (TPB) and Resource-Based View (RBV) frameworks adopted in this study.

The review provides a grounding for detailed studies on Market access, Entrepreneurship, and the role of Water Security in Urban-based Farming**.** The potential of UF in generating income and improving food security for low-income households has been well documented. In less developed countries, particularly African countries, several constraints hinder the progress of UF and such include the planning, cultural attitudes, policy, governance, value chain linkages, and administrative and legal challenges. Rapid urbanization and population growth are global problems. UF has the potential to be an essential economic activity and therefore, governments and policymakers need to acknowledge its benefits. Much literature has occurred on food systems and the concept of food system governance has emerged because of the idea that food systems should be resilient to be able to cope with

environmental and social threats and contribute to food security. Several studies highlight that UF has the potential to improve food security and welfare, however that can be achieved if farmers can actively participate in different levels of the urban agri-value chain to be able to generate income from their farming activities. Therefore, it is important to also study entrepreneurship, value chain participation and market access opportunities within UF. The literature on agricultural entrepreneurship has been focused on the entrepreneurial skills and behaviour of farmers and their sources of income, essentially in European countries. Agricultural entrepreneurs are facing important challenges because agriculture is changing rapidly and there have been recent value chain disruptions such as the COVID-19 pandemic that have reshaped agri-food systems in African counties. Therefore agency, resources and entrepreneurial skills are essential to their success. Attending to the importance of agricultural entrepreneurship studies in rural areas, more studies are needed to address this issue in the urban space, especially the potential of UF for social development and economic growth, based on the community's empowerment. Water availability and use are very important when it comes to fresh produce as they can directly impact market access opportunities, value chain participation, food safety and quality. It is important to study how water governance in urban environments affects UF success and how it affects urban farmers' value chain participation and market access opportunities.

The following chapter (Chapter 3) provides a description of the study areas and details of the

methodology adopted by the study.

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Chapter 3: Research Methodology

3. Methodological approach & research design

3.1 Introduction

The following chapter describes the research procedure. It offers details on the research methodology that was applied in carrying out this study as well as an explanation for its selection. The chapter also covers the several phases of the research such as sampling procedures, data collection procedures, and the techniques used for analyzing the data. This chapter's main components also included the research process, which covered the methodology, study participants, sampling methods, analysis methods, and ethical considerations. The study examined market access, entrepreneurship, and the role of water security in urban-based farming.

This study employed a quantitative research approach to answer the research questions under investigation. Quantitative research approach is defined by Gerrish and Lacy (2010) as 'the broad term used to denote research designs and methods that yield numerical data'. Furthermore, according to Mohajan (2020), quantitative research approaches are appropriate when researchers seek to understand measurable relationships between variables. This study gathered numerical data that was subjected to statistical analysis to investigate relationships between variables of interest. According to Ahmad et al (2019), social scientists use quantitative research approaches to study phenomena affecting individuals and quantitative methodology is the most used research framework in socio-economic studies.

3.2 Description of study areas

The study identified two sites for sampling smallholder urban vegetable farmers. These are Sobantu Township and Mphophomeni Township located in the province of KwaZulu-Natal as shown in Figure 1. Sobantu and Mphophomeni were selected due to their contrasting urban infrastructure, water access conditions, and market proximity, allowing for comparative analysis aligned with the study's objectives**.** Sobantu has a flat topography and is located on the surrounding outskirts of Pietermaritzburg in the Province of KwaZulu-Natal. The area is a residential area compromising both formal and informal settlements. Two rivers namely, the Umsunduzi River and Baynespruit River run through Sobantu. Farmers use tap water and river water as a source of irrigation for smallholder vegetable production, and other human activities such as fishing. Sobantu Township is located on a flood plain with limited further housing development. Nevertheless, the area has a high potential for agriculture because of its good

soils and availability of water. It is observed that agricultural activities include community gardens and

several individual small production units (Tamako et al., 2022). The main vegetables that farmers produce in this area are cabbage, spinach, beetroot, green pepper, butternut, maize, lettuce, onions, and chilies.

To move the Black residents into the environs of Howick, a charming little town in the Natal Midlands, the South African government established the township known as Mpophomeni in 1968 on an open field. Its name, Mpophomeni (isiZulu for "the place of the waterfall"), comes from the famous Howick waterfall. Mphophomeni is a peri-urban township located outside Howick and is governed by the Umngeni Municipality. The area was established to provide housing for people since some people are employed in Howick and Pietermaritzburg (Baiyegunhi & Makwangudze., 2013). However, housing provision has not kept pace with population growth, leading to increased demand and a high unemployment rate making government grants a crucial income for most households. Water access is generally reliable as the municipality provides households with tap water and some households harvest rainwater. Mphophomeni Township was selected for the study as there are several households with home gardens producing vegetables for selling and for home consumption. The main vegetables produced in this area are cabbage, spinach, chilies, onions, and green pepper. The area has a farmers' market that was established in June 2018 to support local farmers. The local farmers supply the farmers' market which has now become a popular event with several food stalls.

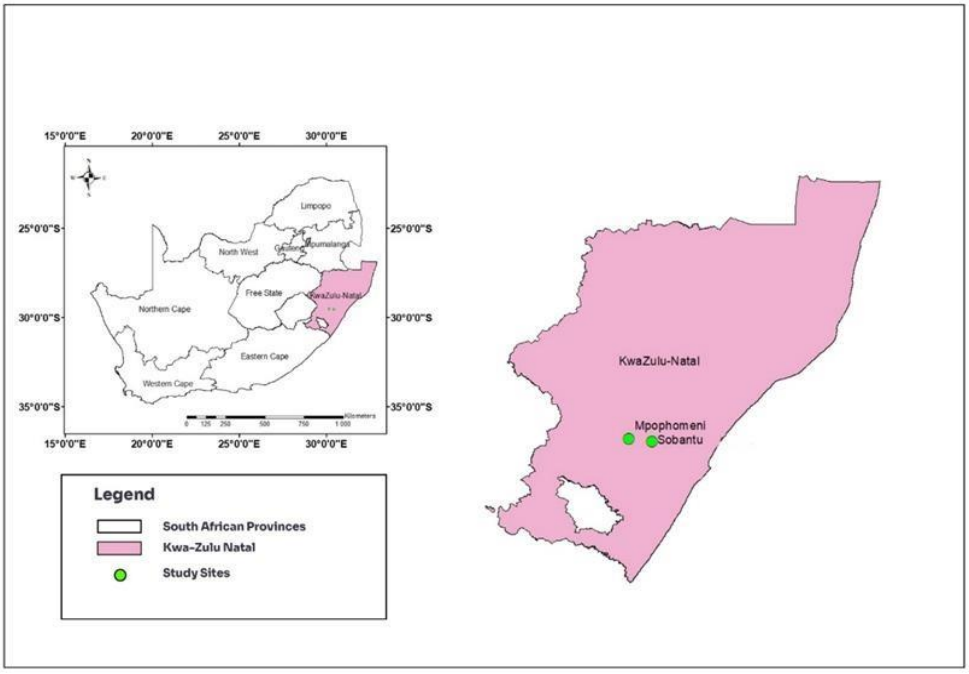

Figure 1: Study location of Sobantu and Mpophomeni townships in KwaZulu-Natal Province

3.3 Sampling Procedures

Sampling is a process of extracting individuals from a population to represent the larger group from which they were selected (Alvi., 2016). According to Levy and Lemeshow (2013), the statistical method of choosing a subset of an interest population to make observations and draw conclusions about that population is known as sampling. This study employed a multi-stage sampling technique for the selection of the study participants. A multi-stage sampling technique is a sampling method in which sampling is done in stages using smaller yet smaller sampling units at each stage (Obilor., 2023).The first stage involved a purposive sampling technique of uMsunduzi & uMngeni Municipalities based on the predominance of households who are involved in UF. According to Taherdoost (2016) who cited Maxwell (2012), a technique known as "purposeful" or "judgmental" sampling involves the intentional selection of specific contexts, people, or events to yield crucial information that cannot be found through alternative options. The second stage also involved a purposive selection of Sobantu and Mphophomeni Townships based on the predominance of urban farmers in the areas, while the third stage involved a proportionate random sampling technique of 156 smallholder urban farmers. This study targeted smallholder urban farmers who produce vegetables for household consumption and to sell at various markets. The sample size of 156 was determined based on prior studies and power analysis ensuring sufficient representation for logistic and structural equation modeling. A confidence level of 95% was targeted.

3.4 Data collection methods and tools

3.4.1 Structured questionnaire

A structured questionnaire that contained both open-ended and closed-ended questions was used to gather the data for this study. The questionnaire was employed to gather information on socio-economic characteristics, markets, smallholder farmer entrepreneurship, water security, and food security. Open-ended questions enabled the respondents to provide in-depth insights into urban smallholder farming practices, market participants, and market access related challenges and opportunities. The questionnaire is comprised of five sections. Section A gathered general information about the respondents. Section B gathered information about markets and the determinants of market participation. Section C gathered information on smallholder farmer entrepreneurial spirit, interest in agricultural entrepreneurship, and entrepreneurial characteristics. Section D gathered information on water security and section E gathered information on Food Security.

3.4.2 Interview methods

Piloting was done to test the reliability of the questionnaire. The study employed one-on-one interviews with the farmers to obtain primary information that can help to answer the research questions. Each interview with the respondent was conducted face to face. The questionnaire was administered during the interview process and the researcher captured the answers from the respondents on the questionnaire. The one-on-one interview process ensured that the researcher was able to obtain primary data by asking open- ended and closed-ended questions to the respondents.

3.5 Data Collection and Analysis

Data was collected using a structured questionnaire through one-on-one interviews with the respondents. Food security data was collected using the Food Insecurity Experience Scale (FIES). The data was coded in Excel and then imported on Stata 18 for analysis. Table 1 shows a summary of the methodological approach used in the study. The table displays the study objectives, data collected per objective, data collection tools used to collect data, and the data analysis techniques that were used to analyze the data to obtain results.

The following sections include empirical data answering addressing the objectives of the study. The chapters include chapter 3, 4 and 6 and concludes with the conclusions and recommendations on the study.

Table 1: Summary of Methodology to Specific Objectives

Objective	**Data to be collected**	**Data collection tool**	**Data analysis**
To identify the determinants of market participation decisions and the level of market participation among smallholder urban vegetable farmers.	- Market outlets. - Market information sources. - Distance to markets. - Marketing constraints. - Market access training.	- Questionnaire	- Descriptive analysis. - Logistic regression. - Fractional probit regression.
To determine the drivers of agricultural entrepreneurship among smallholder urban vegetable farmers.	- Smallholder entrepreneurial spirit. - Farmer interest in agricultural entrepreneurship. - Farmer attitudes. - Entrepreneurial Characteristics.	- Questionnaire	- Descriptive analysis. - Principal component analysis (PCA). - Two-step estimation of the generalized regression model.
To assess the role of water security and market access on entrepreneurial engagement among smallholder urban vegetable farmers.	- Water availability. - Water access constraints. - Water use. - Market access constraints	- Questionnaire	- Descriptive analysis. - Factor model. - Structural Equation Model (SEM).

3.6 Ethical Clearance and Privacy

3.6.1 Informed consent

Before the data collection process could be initiated, the researcher had to obtain consent from the respondents to participate in the study. The respondents were informed on the objectives of the study, and it was highlighted to them that their participation was voluntary in which they could withdraw participation at any stage of the study without penalty. It was made clear that there are no direct monetary benefits for participating in the study. According to Xu et al (2020), informed consent ensures that participants participate in research voluntarily, with a clear understanding of what their participation involves.

3.6.2 Privacy

The participant's identities and personal information were confidential throughout the research process. Once the study is complete, the thesis and data sources such as questionnaires and spreadsheets will remain under the University's research collection.

3.7 Chapter Summary

This chapter provided an overview of the study methodology and research design. Insight into the sampling procedures, data collection procedures, and data analysis were discussed in this chapter. A summary of the methodology to obtain data and results for specific objectives was also provided. The following chapter (chapter 4) provides the empirical results of the study.

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Chapter 4: Drivers of the level of market participation among smallholder urban vegetable farmers in KwaZulu-Natal, South Africa

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Abstract

Urban farming has gained significant recognition and interest in less developed countries as it has the potential to address challenges linked to rapid urbanization, unemployment, and food insecurity. This study aimed to determine the drivers of market participation and the level of market participation among smallholder urban vegetable farmers in the Sobantu and Mphophomeni township areas. Primary data were collected using a structured questionnaire. A multi-stage sampling technique was used to sample 156 smallholder urban vegetable farmers. The data were analyzed using descriptive statistics, and a double-hurdle model. The results indicated that out of a total of 156 smallholder farmers, 127 farmers were market participants and 29 were non-participants. Logistic model results indicated that market participation decision among smallholder urban farmers was significantly influenced by credit use, access to market information, access to labour, and owning a smartphone. Fractional response model result indicated that the level of market participation among smallholder urban vegetable farmers was significantly influenced by age, cooperative membership, free input, storage, and market training. The study concludes that market participation can be enhanced by increasing market information sources through market-empowered extension services and improved access to market information including through targeted radio, television and the Facebook application. The study recommends urban policies and programs by various stakeholders that strengthen market training activities and form farmer co-operatives meet market requirements and to improve market participation among smallholder urban farmers.

Keywords: Market participation, Urban farming, Smallholder farmers, double-hurdle model

4.1 Introduction

A rise in the physical and financial obstacles preventing access to food and the disruption of food supply chains have resulted in an increase in urban food security, and a rise in food waste brought on by a labour shortage (Lal, 2020). The COVID-19 pandemic further increased the stress on urban food systems and thus there is a need to adopt more resilient food systems to strengthen local food production in urban areas. Smallholder urban farming and home gardens can be an important strategy for increasing local production. Smallholder farming is key in sustaining livelihoods and nutritional assurances in less developed countries of sub-Saharan Africa. According to Omiti et al. (2009), the agricultural sector employs people through forward and backward industrial linkages therefore providing food and income for households. In recent years, urban farming (UF) has gained significant recognition and interest in less developed countries as it has the potential to address challenges linked to rapid urbanization, unemployment, and food insecurity. In addition to increasing food supplies, UF has social benefits such as employment opportunities, reduced food transportation distance, and shortened supply chains, carbon sequestration, and waste recycling (Mok et al., 2014). Despite the potential benefits of UF, smallholder farmers frequently struggle to sell their goods in high-end markets (Kwaramba et al., 2023), and therefore, smallholder farmers in less developed countries need to be integrated into the market for them to have improved livelihoods (Olwande et al., 2015).

Market participation affects several aspects of a household that influence their livelihoods, such as income, farm production and food and nutrition security (Hlatshwayo et al., 2022). Several authors define market participation as the proportion of the value of annual crop sales to the total value of crop production. Market participation is thus defined in terms of sales as a fraction of total output as the sum of all production by the household (Rios et al., 2009; Adepoju et al., 2015). Smallholder farmers' market participation can be affected by several factors such as market imperfections, technical incapability, limited marketing knowledge, price instability, and socio-economic factors (Kyaw et al., 2018). Farmers' decisions to invest in the production of fresh produce are heavily influenced by the availability of market information; in the absence of such information, producers who offer modest quantities to unorganized supply chains and informal markets are at risk (Amare et al., 2024). This study aimed to investigate the determinants of market participation among urban smallholder vegetable producers. Several studies have identified the factors that affect market participation for smallholder rural farmers,

but more investigation is needed to identify the significant factors affecting market participation decisions and the level of market participation in an urban setting. Research that investigates how linking urban farmers to markets improves livelihoods through entrepreneurial endowers is important in informing urban development strategies.

To date there are limited studies that have investigated this phenomenon. Although several studies have examined market participation among smallholder farmers in rural areas, limited research has focused on urban smallholder farmers, particularly in the context of rapidly urbanizing regions like KwaZulu-Natal. Existing studies often generalize the challenges of market participation, without fully accounting for the unique socio-economic and institutional factors that shape market access in urban settings. For instance, urban farmers may have different land tenure arrangements, face distinct market dynamics, and engage with a diverse set of buyers compared to their rural counterparts. Additionally, there is a lack of in-depth analysis of how local market structures, such as informal markets or supermarkets, interact with smallholder farmers in these urban environments.

Moreover, the literature tends to focus on constraints at the household level, such as land size, education, and household income, while under exploring meso- and macro-level factors like institutional support, urban planning policies, and the role of intermediaries or cooperatives in facilitating market access. This gap suggests a need for more nuanced studies that not only assess the household characteristics of smallholder farmers but also consider broader systemic factors that influence their market participation. Thus, this study aims to fill the gap by specifically investigating the drivers of market participation among smallholder urban vegetable farmers in KwaZulu-Natal. By identifying key factors at multiple levels (household, institutional, and market-related). This research will provide insights to improve smallholder farmers' integration into urban markets, addressing both the literature gap and practical challenges faced by these farmers.

It is important to understand the drivers of market participation and the level of market participation for smallholder urban farmers so that the correct policy interventions that link smallholder urban farmers to markets can be initiated in urban environments. Farmers' market access is a vital component of market participation and smallholder farmers can access the market by selling to buyers at the farm gate or transporting the produce to the marketplace (Otekunrin et al., 2019). Understanding the driver of market participation decisions and the level of market participation for smallholder urban farmers can be key to urban development.

4.2 Theoretical Review

Age, gender, and educational attainment are important household demographics that influence market participation. Older farmers, for example, can be less inclined to participate in formal markets and more risk cautious, preferring to do business in local or informal settings (Mather & Adelaja, 2017). Furthermore, because of societal norms and limited access to resources, households led by women may encounter additional obstacles to market participation (Nwafor & Akpan, 2020). Farmers' willingness to participate in the market is influenced by their education, which helps them acquire the skills they need for market research and decision-making (Nguyen et al., 2016).

The decision to participate in the market and the level of participation are influenced by several important criteria, including the amount of land under cultivation, the crops grown, and production levels. Larger landholding farmers are more likely to create surpluses that can be sold in marketplaces, according to studies, which increases the possibility that they will participate (Alene et al., 2018). Similar to this, the kind of vegetables grown or high-value crops can affect market participation since high-value crops frequently bring in higher prices and promote larger participation (Chirwa & Matita, 2016). Productivity is another important element. Higher yields from smallholder farmers enable them to more readily meet market demand, increasing their likelihood of participation (Mmbando et al., 2015). Conversely, low productivity might pose a serious obstacle, making it harder for farmers to interact with markets as they aren't producing enough food (Gogo et al., 2021).

The market involvement of smallholder farmers is significantly influenced by their access to institutional support services, including financial facilities, extension services, and market intelligence. Farmers who have more access to extension services are more likely to participate because they are more likely to possess the technical know-how to enhance productivity and understand market dynamics (Jari & Fraser, 2019). Another important factor is the availability of credit; without it, farmers would not be able to increase their output to match demand, which would restrict their ability to participate in the market (Kargbo, 2020). Having access to market information is essential for deciding when, when, and how best to sell produce. Because of the uncertainty involved, a lack of trustworthy market information may discourage market participation (Musemwa et al., 2017). Additionally, farmers who are closer to urban areas where demand is high are more likely to engage than those who are in more rural places; this suggests that distance to the market also plays a role (Baltenweck & Mutinda, 2020).

4.3 Analytical framework

This section provides a detailed description of the analytical frameworks adopted by the study. Firstly, descriptive statistics like frequencies and percentages were calculated to summarize the farmers' profiles and characteristics. Secondly, a double hurdle model was used where the first hurdle involved logistic regression to determine the factors influencing market participation decisions of smallholder urban vegetable farmers, and the second hurdle involved fractional probit regression to determine the factors that influence the level of market participation among smallholder urban vegetable farmers. Table 2 shows the variables that were selected to be used in the selected analytical models.

Table 2: Description of variables used in the empirical models.

Variable	**Description**	**measurement**	**Expected sign**
Market participation	Sell produce	0= no, 1= yes	N/A
Incomeshare	Total income divided by sales income	Proportion	N/A
Gender	Gender of farmer	0= male, 1= female	+
Age	Age of the farmer	Actual years	-
MaritalStatus	Marital status of farmer	0=Single, separated or divorced; 1= Married	-
Education	Education level of farmer	Formal education =1; No formal education=0	+
AgricCoop	Membership of cooperative	0= no, 1= yes	+
Extofficer	Access to extension officer	0= no, 1= yes	+
Govsupport	Receive government support	0= no, 1= yes	+
Farmingtype	Farming type	1= conventional, 2= organic	+
Crediuse	Credit use	0= no, 1= yes	+
Freeinput	Receive free input	0= no, 1= yes	+
Storage	Storage facility	0= no, 1= yes	+
Markettraining	Market training	0= no, 1= yes	+
Accestocredit	Access to credit	0= no, 1= yes	+
Householdsize	Household size	Actual number	+
Laboracces	Access to labour	0= no, 1= yes	+

Market info	Access to market information	0= no, 1= yes	+
Smartphone	Smartphone	0= no, 1= yes	+
Wateravailaible	Water availability	0= no, 1= yes	+

4.4 Logistic Regression Model

In the first hurdle, the study adopted a logistic regression model to identify the factors that influence market participation decisions among smallholder urban vegetable farmers. Mdoda et al. (2019) specified that the logistic regression dimension may be used to evaluate the likelihood relationship for autonomous variables in a model. Logistic regression is suitable for examining the relationship between a binary dependent variable (which has only two categories) and a set of independent predictor variables that can be either continuous or categorical (Wang et al.,2006). The logit model was used for this study because of the dichotomous nature of the dependent variable. The dependent variable that was included in the model that represented market participation was (Sellproduce). The variable is a dummy variable that can only take a value of 0 if the farmer does not sell their produce and 1 if the farmer does sell their produce. For this study, the regression analysis is modelled to elucidate Y=1 to farmers who sell their produce, and Y=0 to farmers who don't sell their produce.

As mentioned by Wooldridge (2009), the assumption that X is described as a pathway for eloquent features, while p is the probability that Y=1, two-way likelihood relationships is well-noted and is captured below:

$$p^{(y=1)} = \frac{e^{\beta x}}{1+e^{\beta x}} \quad (1)$$

$$p^{(y=0)} = 1 - \frac{e^{\beta x}}{1+e^{\beta x}} = \frac{1}{1+e^{\beta x}} \quad (2)$$

$$log\ it\ [\theta(x)] = log\ [\frac{\theta(x)}{1-\theta(x)}] = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots \ldots \ldots \ldots \beta_n X_n \quad (3)$$

The following representations relate:

θ = logistic amendment of the contingency fraction;

β = explanatory variables; and
X_i= predictor or forecaster variables

The logistic model in this study can be stated as follows:

$$Y_1 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \cdots + U_n \quad (4)$$

Where

Y_1(sell produce) = sell produce (1 and 0 otherwise)
α =constant
β = slope of the distinct forecaster variables
X_i = forecaster variables
U_n = alteration or error term

4.5 Fractional probit regression model

In the second hurdle, the study follows the method proposed by Papke and Wooldridge (1996), this study adopted a fractional response model to estimate the level of market participation while taking into account the type of dependent variable. The second stage (level of market participation) equation is expressed as:

$$E(HCI_i / MOPART_i = 1) = f(Z_i, \beta) \quad (5)$$

$$E\left(HCI \mid X_i, HCI > 0\right) = \alpha\left(X_i \Psi\right)$$

where HCI is the observed response on the level of market participation (HCI)[1], E is the expectation operator; Z is a vector of the household characteristics; β is a vector of parameters to be estimated.

4.6 Methodology

4.6.1 Description of Study Areas

The study areas that were selected for the study were Sobantu (29°35′33.86″S, 30°25′12.73″E) and Mphophomeni (29°34′01″S 30°10′55″E), which are both Sub-urban areas located in the

province of KwaZulu-Natal. Sobantu is governed by the uMsunduzi Municipality and Mphophomeni is under the uMngeni local municipality. The study was conducted in the Township areas of both Sobantu and Mphophomeni. Both study areas consist of smallholder urban farmers who mainly produce vegetables such as cabbage, spinach, beetroot, green pepper, mielies and butternut. The farmers produce these crops in small-scale market gardens (typically sold to community members as shown in Figure 2) and subsistence gardens (home consumption). In both areas, urban farming is considered as a strategy for sustaining livelihoods.

Figure 2: Physical marketplace in Sobantu township where farmers sell to communities (source: own image)

4.6.2 Sampling techniques and Data collection tools

The study adopted a quantitative research design where quantitative data was collected through one-on-one interviews using a structured questionnaire. A quantitative research design approach was adopted to quantify data collection and analysis and be able to perform descriptive and statistical analysis. The questionnaire was structured to capture data on farmer demographics, socio-economic characteristics, access to markets, entrepreneurial characteristics, and participation in the market. Before the interviews were conducted, the researcher obtained verbal and written informed consent from the farmers who agreed to be

interviewed. A written informed consent form was submitted and approved by the Human and Social Sciences Research Ethics Committee (HSSREC). 156 Smallholder urban vegetable farmers from the study areas were sampled purposively and interviewed.

A multistage sampling technique was used to sample 156 smallholder urban vegetable farmers in the Sobantu and Mphophomeni areas. A multistage sampling technique has two or more stages of random sampling based on clusters within a population (Sedgwick.,2015). The study used a multistage sampling technique with two stages. The first stage involved a purposive sampling of smallholder urban vegetable farmers in Sobantu and Mphophomeni based on the predominance of smallholder urban farmers in the chosen study areas. As expected for purposive sampling, study objective criteria guide the selection of the participants for a purpose versus just pursuing a large sample (Campbell et al., 2020), in this case, market participation was key. Further, only respondents with farming plots that were producing vegetables were considered as smallholder urban vegetable farmers. In the second stage, a random sample of farmers nested within the selected farmers was obtained to be used as study participants. The data collectors randomly selected a subset of respondents by choosing random farmers with farming plots in the population.

4.6.3 Data analysis methods

Data were collected and coded in MS Excel and transported into Stata 18 for analysis. The study made use of descriptive statistics and econometric models for analyzing the data. Descriptive statistics were used to estimate and provide a summary of the farmer profiles. Econometric models in the form of the logistic model and fractional probit model were used to identify the factors influencing market participation decisions and the level of market participation among smallholder urban vegetable farmers respectively.
To address potential endogeneity, variable selection was guided by theory, and robustness checks were conducted. While the logistic and fractional response models provide robust insights into the determinants of market participation, it is important to acknowledge potential endogeneity concerns, particularly reverse causality between key variables such as training, cooperative membership, and market participation. For instance, farmers who are already participating in markets may be more likely to receive training or join cooperatives, rather than these factors unidirectionally causing participation. To mitigate this, variable selection was informed by established literature and theoretical expectations based on the Theory of Planned Behaviour (TPB), which emphasizes intention and perception preceding action. However, due to the cross-sectional design of the data, the direction of causality cannot be definitively

established.

4.7 Results and Discussion

4.7.1 Farmer socio-demographic profile

The outcomes from the farmer profile in Table 3 indicate that the majority of the interviewed urban farmers were female (79%), and male farmers only amounted to 21% of the sampled farmers (n=156). The outcomes are aligned with the findings of (Hadebe & Mpofu, 2013; Bisaga et al., 2019) who in their studies found that women were most involved in UF because men would generally be employed off-farm elsewhere whilst the women engage in UF activities as they are traditionally given the responsibility of distributing the food in the household. The education background showed that most of the farmers had secondary schooling (44%) as their highest education level followed by respondents having primary schooling (40%) while only 9% had tertiary schooling and 7% with no education. 12% of the respondents stated that they receive a government grant in which this grant includes all other categories of government grant excluding old age pension. The mean age of the respondents was 57 years and 40% of the respondents stated that their main source of income is old age pension suggesting that many of the farmers were elderly. This is aligned with the study of Modibedi et al. (2021) who in their study found that a large proportion of urban farmers were above 55 years of age with very low youth participation.

A high percentage of 81% of the farmers stated that they sell their produce meaning that they participate in the market, and 19% stated that they grow crops for their own household consumption. Interestingly, even though the majority of the farmers were market participants, almost half of the farmers (46%) had no access to market information, and 54% of the farmers had access to market information. The results in Table 3 also show that only 37% of the farmers owned a smartphone.

Table 3: Farmer profile

Socio-demographic variables	Category	Frequency	Percentage
Gender	0= Male	32	20.51
	1= Female	124	79.49
Education	1= None, can't read & write	6	3.85
	2= None, can read & write	6	3.85
	3= Primary school	62	39.74
	4= Secondary school	68	43.59
	5= Tertiary school	14	8.97
	6= Vocational training	0	0
Marital status	1= Never married	97	62.18
	2= Married	30	19.23
	3= Divorced	8	5.13
	4= Widowed	21	13.46
Main income source	1= Government grant	18	11.54
	2= Old age pension	63	40.38
	3= Remittances	10	6.41
	4= Wages	20	12.82
	5= Farm harvest	25	16.03
	6= Non-farm business	20	12.82
Access to credit	0= No	131	83.97
	1= Yes	25	16.03
Market information	0= No	71	46.10
	1= Yes	83	53.90
Sell produce	0= No	29	18.59
	1= Yes	127	81.41
Smart phone	0= No	99	63.46
	1= Yes	57	36.54

Table 4 below shows the descriptive statistics

Table 4: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Accesstocredit	156	.16	.368	0	1
AgricCoop	156	.167	.374	0	1
Extofficer	156	.212	.41	0	1
HouseholdSize	156	3.788	1.507	1	7
Farmingtype	156	0.378	.487	0	1
Sellproduce	156	.814	.39	0	1
Marketinfo	156	.539	.5	0	1
Laboraccess	156	.609	.49	0	1
Smartphone	156	.365	.483	0	1
Freeinput	156	.301	.46	0	1
Wateravailibilty	156	0.724	.994	0	1

4.2.7 Determining factors of market participation decision of smallholder urban vegetable farmers: Logistic model (first hurdle)

The study employed logistic regression to evaluate the factors that affect a smallholder urban vegetable farmer's decision to sell their produce in the market. The findings in Table 5 as indicated showed that fourteen independent variables were used in the logistic model and four variables were identified to be significantly related at different probability levels to the decision of the farmers to participate in the market. The dependent variable (market participation) was measured by asking respondents if they sell their produce (Yes= 1; No= 0), hence, the variable is a dummy variable justifying the choice of the logistic regression. For the Probit model, several diagnostic tests of multiple restrictions (Psudo R2=0.34, Lagrange multiplier, Wald and likelihood ratio tests) revealed that the results gave the best fit.

The coefficient of access to free input is positive and statistically significant in influencing market participation of urban farmers in the study area. This implies that as urban farmers gain access to free inputs such as planting seeds, the propensity to produce more and participate in the market increases. This is evident in the marginal analysis which shows that if access to free farm input increases by 1%, the likelihood of market participation increases by 7.7%. This is in line with the study. This could be attributed to that smallholder urban vegetable farmers who receive free input can combine those inputs with purchased inputs and increase cultivation and production on their farming plots thus increasing the amount of farm produce to sell. These results were contrary to the study of Hlatshwayo et al. (2021) who found a negative relationship between agricultural assistance from various stakeholders as they explain that some extension

agents may provide farmers with free inputs but do not provide the necessary training on how to use the inputs effectively. However, extension agents can still provide smallholder farmers with improved input varieties that can improve production leading to surpluses to be sold in the market (Ndlovu et al 2022).

As indicated in Table 5, access to market information had a positive coefficient and was found to be statistically significant at a 1% confidence level, indicating that having more market information increases market participation among smallholder urban vegetable farmers. This is evident in the marginal analysis which shows that if access to market information increases by 1%, the likelihood of market participation increases by 19.9%. This can be attributed to the fact that farmers who have access to market information have the knowledge of which commodities are demanded by the market and where they can sell their produce. The study of Belete and Nigatu (2023) found a negative sign of the coefficient indicating that a lack of market information reduces the participation of smallholder farmers in the market. The result of this study is similar to the studies of Randela et al. (2008), who found a positive significant relationship between access to market information and participation as they explain that having more access to marketing information reduces transaction costs thus increasing market participation. Furthermore, Sibiza et al. (2011) found similar results, and they argue that access to information reduces risk perceptions.

Table 5: Determining factors of market participation decision of smallholder urban vegetable farmers -Logistic regression result.

Market participation	Coef.	St.Err	p-value	dy/dx	St.Err	p-value
Gender	-0.296	0.389	0.446	-0.030	0.034	0.383
Age	0.020	0.025	0.417	0.002	0.003	0.404
Education	-0.086	0.233	0.711	-0.010	0.027	0.714
Marital Status	-0.138	0.150	0.360	-0.016	0.018	0.389
Access to credit	-0.502	0.460	0.275	-0.075	0.084	0.369
Household Size	0.022	0.107	0.833	0.003	0.012	0.833
Farming type	-0.120	0.333	0.719	-0.014	0.038	0.716
Free input	0.825	0.495	0.096*	0.077	0.039	0.050**
Market information	1.438	0.444	0.001***	0.199	0.070	0.004***
Labor access	0.904	0.367	0.014**	0.126	0.065	0.052*
Water availability	-0.044	0.186	0.815	-0.005	0.022	0.816
Credit use	-1.333	0.457	0.004***	-0.255	0.101	0.012**
Smartphone	0.918	0.530	0.083*	0.092	0.048	0.052*
Extension services	0.478	0.355	0.178	0.055	0.039	0.157
Constant	-0.955	2.220	0.667			
Pseudo r-squared	0.339					
Chi-square	49.569					
Akaike crit. (AIC)	126.466					
Bayesian crit. (BIC)	172.020					
SD dependent var	0.387					
Number of obs	154.000					
Prob > chi2	0.000					

*** p<0.01, ** p<0.05, * p<0.1

The results in Table 5 show that labor access had a positive coefficient and was found to be statistically significant at a 5% confidence level, depicting that if smallholder urban vegetable farmers have access to more labor, the probability of participating in the market will increase. This is evident in the marginal analysis which shows that if access to labor increases by 1%, the likelihood of market participation increases by 12.6%. A possible explanation is that farmers who have access to labor whether 'hired' or 'household labor' can produce a surplus that can be sold to the market. The result is consistent with the study of Osmani and Hossain (2015), who posited that households with a large number of household labor can reduce their production costs and produce a surplus that can be sold in the market. A study conducted in South Africa by Bahta and Bauer (2012); Hlatshwayo et al. (2023) also found a similar result in their study.

The result in Table 5 shows that the use of credit had a negative coefficient and was found to be statistically significant at a 1% confidence level, indicating that an increase in the use of credit by farmers will reduce the probability of market participation by smallholder urban vegetable farmers. This is evident in the marginal analysis which shows that if the use of credit increases by 1%, the likelihood of market participation decreases by 25.5%. Contrary, other studies (Alene et al., 2007; Abayneh & Tefera., 2013; Mbitsemunda & Karangwa., 2017; Omodara et al., 2021; Mncube et al., 2023) found a positive significant relationship between credit and farmers' decision to participate in the market since credit enables farmers to buy improved inputs and production technologies that can increase production and leading to marketable surpluses. The negative relationship in this study could be attributed to that in an urban setting, farmers may opt to use credit for other non-agricultural income-generation activities and investments that may have a higher return than fresh produce.

As presented in Table 5, smartphone had a positive coefficient and was found to be statistically significant at a 10% confidence level, depicting that owning a smartphone increases the probability of smallholder urban vegetable farmers participating in the market. This is evident in the marginal analysis which shows that if using a smartphone increases by 1%, the likelihood of market participation increases by 9.2%. This can be attributed to that farmers who own a smart phone can access market information using the internet and social media platforms. The use of smartphones indicates a proxy for digital literacy and access to market information platforms, directly influencing market participation. The result of this study is consistent with the studies of Chikuni and Kilima (2019) and Mthethwa et al. (2022) who suggested that having a mobile phone with a market information system had a significant effect on promoting smallholder farmers' participation in markets. Furthermore, Musungwini (2018), posited that the use of mobile applications could facilitate communication between smallholder farmers input suppliers, and agricultural product buyers.

4.2.8 Factors affecting the level of market participation of smallholder urban vegetable farmers: Fraction response model (second hurdle)

The study employed fractional probit regression to evaluate the factors that affect the level of market participation among smallholder urban vegetable farmers. The level of market

participation was measured as (Income share) where the total income received by farmers was divided by the sales income received from selling vegetables. In correcting the possible sample selection bias in this model, the Probit model was used in the first stage to generate a sample selection correction term, referred to as the inverse Mills' ratio (IMR), and then used as an independent variable in the fractional response model (Wooldridge, 2002). The coefficient of the IMR turned out to be statistically significant in the fractional response model, indicating that self-selection bias was an issue if the model had been jointly estimated. Findings as indicated in Table 6 showed that twelve independent variables were used in the Fractional response model, and five variables were discovered to be significantly related to influencing market participation levels among smallholder urban vegetable farmers in the study areas.

Table 6: Factors affecting the level of market participation of smallholder urban vegetable farmers -Fractional probit regression result.

Income share						
	Coeff	Robust std. err	P>z	dy/dx	std. err	P>z
Gender	0.036	0.155	0.815	0.014	0.058	0.815
Age	-0.011	0.006	0.093*	-0.004	0.002	0.092*
Marital Status	0.039	0.069	0.577	0.014	0.026	0.576
Education	-0.061	0.087	0.485	-0.023	0.032	0.484
Agric Coop	0.458	0.145	0.002***	0.158	0.046	0.001***
Extension services	-0.069	0.078	0.379	-0.026	0.029	0.378
Government support	-0.178	0.144	0.216	-0.067	0.055	0.223
Farming type	-0.148	0.140	0.292	-0.055	0.052	0.294
Storage	0.335	0.140	0.016**	0.117	0.045	0.010**
Road condition	-0.227	0.070	0.001***	-0.084	0.026	0.001***
Household size	0.025	0.047	0.595	0.009	0.018	0.594
Input market distance	-0.039	0.021	0.069*	-0.015	0.008	0.070*
Inverse mills ratio	2.080	0.376	0.000***	0.773	0.148	0.000***
Constant	0.049	0.802	0.951			
Log pseudolikelihood	-87.784					
Pseudo R2	0.1340					
Wald chi2(13)	74.41					
Prob > chi2	0.0000					

*** p<0.01, ** p<0.05, * p<0.1

The result in Table 6 shows that age had a negative coefficient and was found to be statistically significant at a 10% confidence level, depicting that as the farmer gets older, their level of market participation decreases. This is evident in the marginal analysis which shows that if the age of the farmer increases by 1 unit, the likelihood of market participation level decreases by 0.4%. This could be attributed to the fact that older farmers are not up to date with technology such as smartphones that can reduce the transaction costs of accessing marketing information

that will allow them to participate successfully in the market. The result is consistent with the study of Andaregie et al. (2021) who found that age had a negative significant relationship with the level of market participation the authors explain that this can be attributed to the fact that older farmers cannot access information on inputs and marketing.

As indicated in Table 6, the agricultural cooperative had a positive coefficient and was found to be statistically significant at a 1% confidence level, depicting that being a member of an agricultural cooperative increases the level of market participation. This is evident in the marginal analysis which shows that if membership to an agricultural cooperative increase by 1%, the likelihood of market participation level increases by 15.8%. This could be attributed to that agricultural cooperatives enable farmers to be able to share market information and inputs. The result is consistent with the results of Tefera et al. (2019), who found that cooperative membership was significantly and positively related to the level of participation in agricultural output marketing. The study of Sebatta et al. (2014) also found that farmers' membership in a group or marketing cooperative had a positive and significant influence on the volumes sold in a market. The authors explained that working in groups creates collaboration among the farmers and enables them to access market information and farming experience.

As presented in Table 6, storage had a positive coefficient and was found to be statistically significant at a 5% confidence level, depicting that having a storage facility increases the market participation level among smallholder urban vegetable farmers. This is evident in the marginal analysis which shows that if storage increases by 1%, the likelihood of market participation level increases by 11.7%. This could be attributed to that farmers with storage facilities can sell more produce because they can store their produce after harvest and sell it at different times in the market without it being damaged by pests or extreme weather due to the produce being left on the farming plots for extended periods. According to Jari and Fraser (2012), households with storage facilities can sell their produce when the prices are higher because they do not need to sell their produce immediately after harvest when prices are relatively low. The result is aligned with the result of Changalima and Ismail (2022) who found that having access to storage facilities had a positive and significant relationship with market participation.

The coefficient of road condition is negative and statistically significant in influencing the level of market participation of urban farmers in the study area. This implies that if the roads are in

poor condition, it decreases the level of market participation among smallholder urban vegetable farmers. This can be attributed to the fact that better road conditions and good road infrastructure enable smooth transportation of agricultural commodities from the farm to the market (Kyaw et al., 2018). Furthermore, the study of Omiti et al (2009), found that road condition is one of the factors that influence the intensity of market participation among smallholder farmers in Kenya.

The result in Table 6 shows that the distance to the input market had a negative and statistically significant in influencing the level of market participation of urban farmers in the study area at 10% confidence level. The result implies that if the distance to input markets is increased, the level of market participation among smallholder urban vegetable farmers is decreased. This is evident in the marginal analysis which shows that if the distance to the input market increases by 1%, the likelihood of market participation level decreases by 1.5%. This could be attributed to the fact that smallholder urban farmers may not have the incentive to intensify market participation if the inputs markets are further away from the farms as accessing inputs can have high transaction costs. The study by Adams et al (2020), found that the distance to the nearest input market influences farmer's access to input markets. Therefore, limited access to input markets can have a negative influence on farmers to intensify market participation.

Although gender was included as a control variable, a deeper examination reveals structural and practical barriers that disproportionately affect female urban farmers' ability to access markets. Female farmers often face constraints such as limited access to transport, lower access to market information, and reduced ownership of productive assets, including land and smartphones, which were significant in this study. These barriers stem from broader socio-economic dynamics, including traditional gender roles and institutional biases that hinder women's full participation in the value chain. While male farmers were more likely to sell in physical marketplaces and access formal buyers, female farmers tended to rely on informal sales within their immediate communities, resulting in lower levels of market integration and income. These findings support calls for gender-responsive policy interventions, such as women-focused market access programs, subsidized transportation schemes, and inclusion in agricultural cooperatives.

4.3 Chapter Summary

The study aimed to identify the factors that influence market participation decisions and the level of market participation among smallholder urban vegetable farmers in the Sobantu and Mphophomeni township areas. The Logistic model result indicated that market participation

decision among smallholder urban farmers was significantly influenced by credit use, access to market information, access to labor, free input, and owning a smartphone. The fractional response model result indicated that the level of market participation among smallholder urban vegetable farmers was significantly influenced by age, cooperative membership, storage, road condition, and input market distance. The study concludes that market participation can be enhanced by providing free inputs or establishing government input subsidy programs and increasing market information sources through market-empowered extension services and improved access to market information including through targeted radio, television, and Facebook. The level of market participation can be improved by the involvement of younger farmers for the sustainability of farming a possible innovation for market participation and forming agricultural cooperatives while improving the road conditions to allow free flow of movement of goods to the market. The study recommends urban agricultural policies and programs by various government and non-government stakeholders to strengthen market information sources while establishing farmer co-operatives to aggregate farmers to combine produce and sell as a group to improve market participation among smallholder urban vegetable farmers.

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Chapter 5: Drivers of agricultural entrepreneurship among smallholder urban vegetable farmers in KwaZulu-Natal, South Africa

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Abstract

Agricultural entrepreneurship has been recognized as an important tool for job creation and alleviating poverty and improving food and nutrition in South Africa. This study aimed to determine the drivers of agricultural entrepreneurship among smallholder urban vegetable farmers in the Sobantu and Mphophomeni township areas. Primary data were collected using a structured questionnaire. A purposive multi-stage sampling technique was used to sample 156 smallholder urban vegetable farmers. The agricultural entrepreneurship index was created using principal component analysis and used as a dependent variable to determine factors influencing agricultural entrepreneurship in a two-step generalized least-squares (GLS) model for dealing with multiplicative heteroskedasticity. The results indicated that entrepreneurial spirit, entrepreneurial attitude, farming interest, gender, education, farming information, selling produce, and the distance to input suppliers were significant factors that influenced agricultural entrepreneurship among smallholder urban vegetable farmers in the study areas. The study concludes that, agricultural entrepreneurship can be enhanced in urban settings through improvement of farming information and empowerment of urban farmers to improve entrepreneurial spirit, entrepreneurial attitude, and farming interest among the farmers. The study recommends urban policies and programs that strengthen farming information sources and entrepreneurship training activities to improve agricultural entrepreneurship endeavours among smallholder urban farmers.

Keywords: agriculture; entrepreneurship; smallholder farmers, urban farming

5.1 Introduction & contextualization

Entrepreneurship has been recognized as an important tool for job creation and alleviating poverty in South Africa (Herrington et al., 2010; Zaca et al., 2021). According to Also et al (2011), entrepreneurship has always been an important component of the agricultural sector in which agriculture is a unique case that can be scrutinized separately from other forms of economic activity. In the agricultural sector, entrepreneurial opportunities are created through agricultural activities such as developing new agricultural commodities, driving the business process, distribution, and marketing (Pindao and Sánchez, 2017). Urban Farming (UF) has shown great potential for creating entrepreneurial activities in less developed countries (Vermeiren et al., 2013). The role of UF in contributing to poverty alleviation and food security has been studied by several studies (Burger et al., 2009; Cloete et al., 2009; Ruysenaar, 2013; Battersby et al., 2015; Swanepoel et al., 2021) in South Africa. The study of Swanepoel et al (2021) found that households who engaged in UF benefited from improved nutritional status and generation of income through producing and selling food commodities. Even so, entrepreneurial activities through UF are faced with rapid changes and challenges that emerge because of various factors that are internal and external to the farm and agricultural firms always must adapt to market changes, changing consumer behavior, enhanced environmental regulations, new requirements for product quality, and food safety (Lans et al., 2013).

Over the recent years, the South African government has designed urban policies aimed at enhancing agricultural development in urban areas. UF is usually associated with food production and economic growth, however, recent highlights have shown that UF can also improve social capital, strengthen food systems, create jobs, and improve community well-being and access to healthy food (Kullu et al., 2020). According to Cele and Wale (2020), the National Development Plan (2012), emphasizes that expansion of agri-businesses is key for agricultural development. However, the expansion of agri-businesses without strengthening strategies that link smallholder farmers to markets can hinder smallholder farmers from being successful entrepreneurs. According to Mokgomo et al (2022), the government of South Africa has offered various agricultural development interventions to rural smallholder farmers and these interventions have been fruitful in improving agricultural production, reducing food insecurity, and increasing their income. However, the link between entrepreneurship and UF has not been fully explored, and the impact of government assistance on agricultural development in urban areas needs more investigation. Therefore, understanding the factors that influence agricultural entrepreneurship in a UF context is key for developing and implementing

interventions and policies that can link smallholder urban farmers to markets to increase the chances of urban smallholder farmers becoming successful entrepreneurs. A study conducted in KwaZulu-Natal province by Wale et al (2021) examined the drivers of rural smallholder farmer engagement in entrepreneurial activities and found that factors such as market access, gender, income, access to extension and being a member of a cooperative, all positively influenced the farmers' behavior towards agricultural entrepreneurship. Since it is evident that agricultural entrepreneurship is important for the growth of the economy, it is imperative to find ways to enhance it with appropriate policy implementation that considers the factors that influence farmers from engaging in entrepreneurial activities (Khan et al., 2022). Therefore, this study aims to determine the factors that influence agricultural entrepreneurship among smallholder urban vegetable farmers. The study contributes to the body of knowledge as not much is known about the drivers of agricultural entrepreneurship in an urban and sub-urban context and the linkages between UF and entrepreneurship have not been fully explored. Studying the drivers of agricultural entrepreneurship can help develop interventions to address the challenges that restrict smallholder urban farmers from engaging or expanding their agricultural entrepreneurial activities. The following section in this paper provides and analytical framework of the study with a description of the variables used in the empirical model.

5.2 Analytical framework

This section provides a detailed description of the analytical frameworks adopted by the study. Firstly, descriptive statistics like frequencies and percentages were calculated to summarize the farmers' profiles and characteristics. Secondly, a two-step estimation of the generalized regression model was used to identify the factors influencing agricultural entrepreneurship. Table 7 shows the variables that were selected to be used in the analytical model.

Table 7: Description of variables used in the empirical model.

Variable	**Description**	**Measurement**	**Expected sign**
Entrepreneurship	Entrepreneurship	Composite Index	N/A
ENT_SPIRIT_01	Entrepreneurial spirit	N/A	+
ATTI_ENTRE_01	Entrepreneurial attitude	N/A	+
FARM_INT_01	Farming interest	N/A	+
MKT_ACCESS	Market access	N/A	+
Gender	Gender of the farmer	0= male, 1= female	-
Age	Age of the farmer	Numeric	-
Education	Education level of farmer	1= none, 2= none, 3= primary, 4=	+

		secondary, 5= tertiary, 6= vocational	
MaritalStatus	Marital status of farmer	1= never married, 2= married, 3= divorced, 4=widowed	+
Extofficer	Access to extension officer	0= no, 1= yes	+
Accesstocredit	Access to credit	0= no, 1= yes	+
AgricCoop	Member of Agric Cooperative	0= no, 1= yes	+
HouseholdSize	Household size	Numeric	+
Farminfo	Farming information	0=None 1=Radio/television 2=Extension officer 3=Cell phone/SMS 4=Internet 5=Newspaper 6=Other farmers	+
Sellproduce	Sell produce	0= no, 1= yes	+
Inputdistance	Distance to input supplier	Numeric	-

5.2.1 Conceptual framework

The TPB framework informed variable selection and analysis, particularly around entrepreneurial attitude, perceived control, and subjective norms influencing behaviour. The study of Cele and Wale (2020) used a multivariate general linear model (MGLM) and ordered probit models to examine smallholders' entrepreneurial drive in KwaZulu-Natal. MGLM is a useful tool for simultaneous inference on multiple dependent variables (Hair et al., 2010), and it uses Type III sums of squares option which tests the unique contribution of each independent variable by removing the effects of all other independent variables. This study used the two-step generalized least-squares (GLS) method to address any issues of multiplicative heteroskedasticity. Harvey (1976) introduced the two-step generalized least- squares method for dealing with multiplicative heteroskedasticity. This study employed the two-step GLS method, a robust statistical technique developed to handle heteroskedasticity and provide efficient parameter estimates. The two-step GLS estimation is well suited for situations where the variance-covariance structure of errors is known or can be estimated and was adopted by this study to yield results that are more reliable and robust.

5.2.3 Model specifications: Two-step GLS estimation

Let Y be an $n\times1$ vector of dependent variables, X an $\times n\times k$ matrix of independent variables, and ε an $n\times1$ vector of error terms.

The model can be represented as:

$$Y=X\beta+\varepsilon \quad .(1)$$

where:

Y is the dependent variable vector,

X is the matrix of independent variables,

β is a $k\times1$ vector of coefficients to be estimated,

ε is the vector of random errors.

The error term ε is assumed to follow a multivariate normal distribution with mean zero and covariance matrix Σ, i.e., $\sim(0,\Sigma)\varepsilon\sim N\ (0,\Sigma)$. The covariance matrix Σ may exhibit heteroscedasticity and/or serial correlation. Therefore, to account for such issues, the GLS method involves two steps:

In the first step, we estimate the variance-covariance structure of the errors, recognizing the presence of multiplicative heteroskedasticity, the variance of the error term is modelled as a function of the relevant independent variables. This step involves estimating the parameters of the variance-covariance matrix, allowing for a more accurate representation of the data's inherent heterogeneity. In the second step, we conduct the GLS regression, unlike the ordinary least squares (OLS) regression, GLS accounts for the heteroskedastic nature of the errors by weighting each observation based on its estimated variance. Mathematically, the GLS estimator is given by:

$$\hat{\beta}_{GLS}=(X^TWX)^{-1}X^TWy \quad (2)$$

where:

- $\hat{\beta}_{GLS}$ is the GLS estimator of the coefficient vector.
- X is the matrix of independent variables.
- Y is the vector of dependent variables.
- W is the diagonal matrix of weights, derived from the estimated variance-covariance structure.

By incorporating the weights based on the estimated variance, the GLS method effectively mitigates the impact of heteroskedasticity on parameter estimates, yielding results that are more reliable and robust.

5.3 Study Methodology

5.3.1 Description of Study Areas

The study was conducted in Sobantu and Mphophomeni Township located in the province of KwaZulu-Natal in South Africa. Sobantu Township is an urban area under the uMsunduzi local Municipality, and it is comprised of households that have small farming plots for agricultural activities, mainly vegetable production. The smallholder urban farmers produce vegetables to sell to various markets and some produce mainly for home consumption. The common vegetables that are produced consist of cabbage, spinach, beetroot, green pepper, chilies, onions, mielies and butternut. In this study area, water from the tap, harvested rainwater and river water is used for irrigation since the uMsunduzi River flows across Sobantu Township as shown in Figure 3.

Figure 3: Map of Sobantu Township (Source: Google Images)

Mphophomeni Township is a sub-urban area governed by the uMngeni local municipality and is located 28.3 km away from the city of Pietermaritzburg (figure 4). The area consists of formal and informal settlements in which households engage in various agricultural activities such as crop production and livestock keeping. Urban farming activities are a strategy for sustaining livelihoods for some households who produce in small market gardens. The smallholder urban farmers sell their agricultural commodities to various markets including fresh produce markets, Schools, and community members. The farmers at Mphophomeni Township rely on water sources such as tap water provided by the municipality and harvested rained water for irrigation.

Figure 4: Map showing the location of Mphophomeni (Source: Google Images)

5.3.2 Data collection & sampling technique

The study adopted quantitative research approaches where data were collected through one-on-one interviews using a structured questionnaire. The questionnaire was designed to capture data on farmer demographics, socio-economic characteristics, entrepreneurial spirit, farmer interest in agricultural entrepreneurship, farmer attitudes and entrepreneurial characteristics of the urban-based farmers. A sample size of 156 smallholder urban farmers was sampled in Sobantu (n=101) and Mphophomeni (n=55) Township using a multi-stage sampling technique. Multi-stage sampling is a complex form of cluster sampling in which two or more levels of units are embedded one in the other (Acharya et al., 2013). The first stage involved a purposive sampling technique based on the predominance of smallholder urban vegetable farmers in Sobantu and Mphophomeni. In the second stage, a proportionate random sampling technique was used to select vegetable farmers in the study area.

5.3.3 Data analysis methods

Data were collected and coded in Microsoft Excel and exported to STATA version 18 for analysis. The study analyzed the data using descriptive statistics, Principal component analysis (PCA), and an econometric model. Descriptive statistics were used to estimate and provide a summary of the farmer profiles. An econometric model in the form of the two-step generalized least-squares (GLS) model was used to identify the factors influencing agricultural entrepreneurship among smallholder urban vegetable farmers.

5.4 Results & discussion

Table 8 shows the socio-economic profile of smallholder urban vegetable farmers in the study areas.

Table 8: The profile of urban vegetable farmers in the study area

Socio-demographic variables	Category	Frequency	Percentage
Gender	0= Male	32	20.51
	1= Female	124	79.49
Education	1= None, can't read & write	6	3.85
	2= None, can read & write	6	3.85
	3= Primary school	62	39.74
	4= Secondary school	68	43.59
	5= Tertiary school	14	8.97
	6= Vocational training	0	0
Marital status	1= Never married	97	62.18
	2= Married	30	19.23
	3= Divorced	8	5.13
	4= Widowed	21	13.46
Extension officer	0= No	123	78.85
	1= Yes	33	21.15
Access to credit	0= No	131	83.97
	1= Yes	25	16.03
Agric Co-op	0= No	130	83.33
	1= Yes	26	16.67
Sell produce	0= No	29	18.59
	1= Yes	127	81.41
Farm info	1= Radio/television	2	1.28
	2= Extension officer	10	6.41
	3= Cell phone	9	5.77
	4= Internet	23	14.74
	5= Newspaper	1	0.64
	6= Other farmers	111	71.15

The outcomes from the farmer profile in Table 8 indicate that most of the urban farmers were female (79%), and male farmers only amounted to 21% of the total sample of farmers (n=156).

The outcomes are aligned with the findings of Chenarides et al (2021) who found that more females participated in urban farming during and after the Covid-19 pandemic. The majority of the farmers had secondary schooling (44%) as their highest education level followed by farmers having primary schooling (40%) while only 9% had tertiary schooling and 7% with no education. The mean age of the farmers was 57 years and 62% of the sampled farmers stated that they were never married. The result in Table 2 indicates that 79% of the farmers did not have access to an extension officer and farmers who did have access to an extension officer only amounted to 21% of the total sample. The outcomes also indicated that 71% of the farmers obtained farming information from other farmers, while only 6% of the farmers obtained farming information from the extension officer. Most of the farmers (81%) sell their vegetable produce to various markets thus indicating that they are involved in agricultural entrepreneurship endeavors.

5.4.1 Principal component analysis (PCA) results: generation of Entrepreneurship Index

Variables for PCA were selected based on theory and prior empirical research linking entrepreneurial traits with behaviour. Multicollinearity was tested using VIF scores, all below the threshold of 10. The subset of variables used in the analysis in this study was used to measure smallholder entrepreneurship and measured as categorical ordinal variables using the Likert scale. The subset was composed of 10 variables/attributes measuring the ability to take risks, seize opportunities, problem-solving ability, proactiveness, independence, innovativeness, competitiveness, embrace change, discipline/self-control, and foresight (good vision). The analytical strategy was to use principal components analysis to generate a composite index measuring characteristics that define aspects of the observed entrepreneurship which can be assessed over subgroups of farmers' demographics recorded in the data. The data should be suitable for data reduction. Effectively we need to have adequate correlations between the variables for variables to be reduced to a small number of components. This is tested using Bartlett's Test of Sphericity. Bartlett's test of sphericity calculates the determinant of the matrix of the sums of the products and cross-products from which the intercorrelations matrix is derived. Table 9 shows the results of Bartlett's Test of Sphericity.

Table 9: Results for Bartlett's Test

Statistic	Value
Chi-Square (□2)	682.548
Degrees of freedom (df)	91
P-value	0.0000

The correlation test was performed by comparing correlation coefficients that are valid in the data. While the polychoric correlation coefficient was utilized, the Kendall Tau correlation test was also used to triangulate the data, since the latter allows for the calculation of p-values and other essential metrics for testing statistical significance. The computed polychoric correlations were positive and showed at least a medium effect size relationship between each pair of variables. The polychoric correlation matrix was utilized in running the principal components analysis. Thus, the data meets the minimum tests and assumptions required for performing principal components analysis. The analysis was done using the polychoric correlation matrix to account for the ordinal structure of the data.

Through PCA, four components explaining 77% of the variation in the original variables were extracted as representative of the original variables based on their underlying correlations. Component 1 with eigenvalue (4.16) accounts for 41.64% of the total variation represented. Component 2 with eigenvalue (1.57) accounts for 15.7% of the total variation represented. Component 3 with eigenvalue (1.03) accounts for 10.31% of the total variation represented. Finally, component 4 with eigenvalue (0.94) accounts for 9.35% of the total variation represented. Thus, each marginal component captures a declining share of the variation accounted for in the original variables. Before using visual charts, the component loading matrix was examined to assess the distribution of variables and their characteristic representation on each component.

Table 10: Rotated Component Loadings for Entrepreneurship.

Variable	Component 1	Component 2	Component 3	Component 4	Uniqueness (Unexplained)
Control	0.6278				0.1405
Good vision	0.6065				0.2317
Change	0.4045			0.3124	0.2645
Independent				0.8083	0.1369
Proactive			0.5818		0.2085
Competitive				0.3249	0.3971
Problem-Solving			0.7013		0.1199
Innovative		0.5327			0.2994
Seize Opportunity		0.4336	0.3265		0.2798
Risktaker		0.6564			0.2218

Component 1 is composed of variables measuring aspects of control, good vision, and change (adaptability to change), with the highest loading with the factor being associated with the variable “control” (0.6278). Component 2 is composed of variables innovativeness, seize

opportunity, and risktaker with the highest loading of variable, "risktaker" (0.6564). It is noteworthy that these factors are associated with outward-looking type business owners scanning the external environment for new opportunities to expand business through innovation, developing opportunities, and risk-taking. The cross-loading of the variable "seize opportunity" between component 2 and component 3 can be observed although the larger loading is associated with component 2. Component 3 is composed of the variables proactiveness, problem-solving, and seize opportunities with problem-solving being the variable with the largest loading with the component of 0.7013. Finally, component 4 is composed of variables, change, independence, and competitiveness, with "being independent" being the single dominant variable explaining this component.

Given the respective contribution associated with these components, the entrepreneurial characteristics most dominant in the sample are represented by component 1, with variables, control, good vision and adaptability to change most likely showing that the businesses are mostly focusing on aligning their businesses with the changing circumstances of the farming environment. While aspects involving risk-taking, innovation and developing opportunities may be associated with growth and expanding businesses, they are not dominant traits in the data among the sampled participants.

Table 11: Post-estimation KMO values

Variable	**KMO Statistic**
Control	0.6942
Good vision	0.7243
Change	0.7478
Independent	0.7138
Proactive	0.6118
Competitive	0.6813
Problem-solving	0.5572
Innovative	0.8669
Seize opportunity	0.6038
Risk taker	0.5488
Overall	**0.6668**

The measure of sampling adequacy, Kaiser-Meyer-Olkin (KMO), was 0.67 greater than 0.5 which is regarded as appropriate (Boubker et al., 2022), indicating good inter-relationship

among the variables. The post-estimation KMO values associated with each variable show where remedial action is required in the sample. Sampling was excellent for the measurement of innovation, middling for variables, good vision, change, and independent, while it was mediocre for variables control, proactive, and competitive. For the variables problem-solving and risk-taker sampling was inadequate. The effect on the depression of the overall KMO value is observable. The distribution of the variables on each component is summarized in the Figure below.

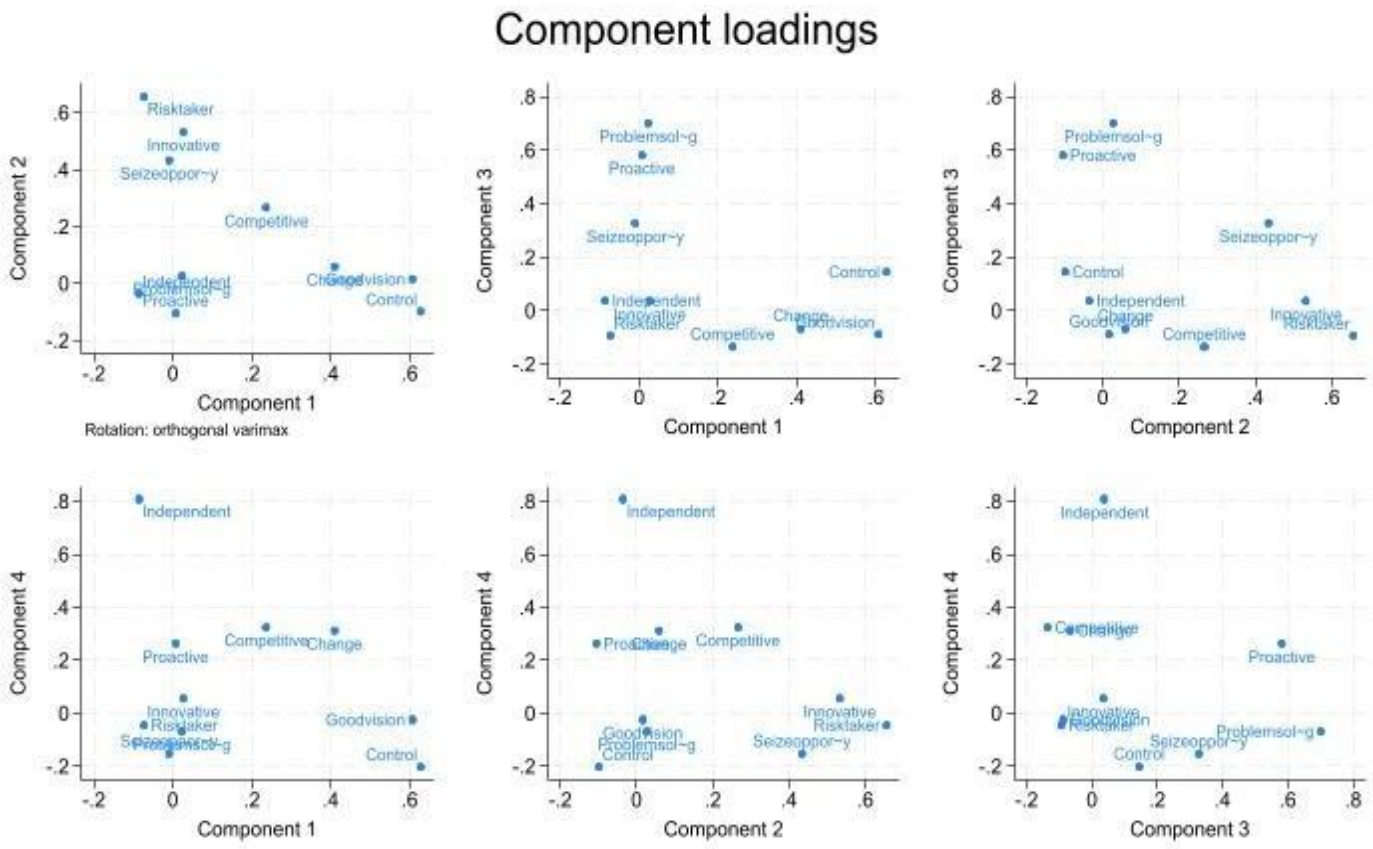

Figure 5: Loading plot.

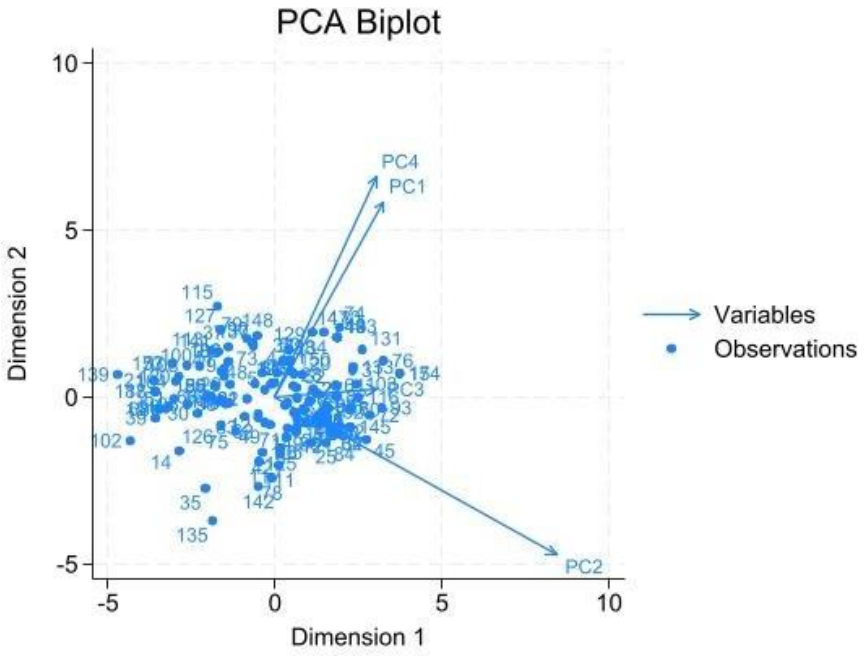

Figure 6: Biplot of the principal components

The biplot in the chart above (figure 6) shows the four principal components plotted together with the observations of the data labeled by observation numbers. The components are distributed in two dimensions based on the correlations among the observations. The component score plot along the axis shows the location of each observation (data point) in the reduced dimensionality space defined by the principal components. Points closer together tend to be more similar in the original data. The data points in the chart can be seen to form clusters of observation consistent with the four eigenvalues behind the four principal components.

The arrows in the chart show the variables defining the PCs, their direction, and length. Points in the same direction as the arrows have positive correlations with the corresponding PC. The intercorrelations among observations defining principal components PC1 and PC4 are observed with the closeness of the two components. The variables in this dimension of the biplot (dimension 2) account for a combined 20.19% of the variation in the original data points. A few data points can be shown to be clustered around these two principal components. These may show some inter-relationships among characteristics defined by the principal components in the original data. The variable measuring change shows a cross-loading between the two components and large positive correlations between change and control, change and independent, and change and competitive. Individuals demonstrating one set of these

characteristics (PC1) and expected to demonstrate the traits explained by the second component (PC4), although generally, these traits were not dominant among the participants in the data sample. As the values of KMO (sampling adequacy) showed, the sample needed more observations around the data points measured by most of these variables. The longer arrows between PC1 and PC4 show very strong positive correlations between the variables explaining these components.

Principal components PC2 and PC3 load effectively on dimension 1 and account for 56.94% of the total variation in the original data points. The data points loading onto these components are positively correlated and the data points can also be observed to be clustered around these two components. The correlation between PC2 and PC3 is not stronger given the length of the arrows representing the two components. There are strong correlations between variables seize opportunities and problem-solving and risktaker and seize opportunities with the variable seize opportunities cross-loading onto both components with similar loading sizes. Individuals who demonstrate characteristics of innovativeness, ability to seize opportunities, and risk-taking are likely to be proactive, demonstrate problem-solving abilities, and can seize opportunities offered by the market. These traits were more dominant in the original data points, although sampling adequacy issues are paramount in some of the variables.

5.4.2 Factors influencing agricultural entrepreneurship: Two-step GLS estimation.

The two-step estimation of the generalized regression model was run on STATA version 18. From the fifteen predictor variables fitted in the two-step GLS model, nine variables had a statistically significant influence on entrepreneurship. Six of the significant variables were positively signed with entrepreneurship, suggesting that an increase in either of these variables would be associated with an increase in entrepreneurial activity. Entrepreneurship was the variable of interest and identifying the significant factors influencing were discovered using the two-step GLS model. Smallholder urban farmers producing vegetables sold their vegetables at various markets thus indicating entrepreneurial characteristics.

The results of the two-step estimation of the generalized regression model are presented in Table 12. The coefficient of entrepreneurial spirit (ENT_SPIRIT_01) had a positive and significant effect (1% level) on agricultural entrepreneurship among smallholder farmers. The result depicts that as entrepreneurial spirit increases, the probability of participating in agricultural entrepreneurship endeavors is increased. This could be attributed to the fact that an increase in entrepreneurial spirit increases self-motivation, attitudes, and willingness to take

risks in agricultural entrepreneurship endeavors among smallholder urban vegetable farmers. The result of this study substantiates the findings of Kibirige and Obi (2015), who in their study found that farmers with higher entrepreneurial spirits can adopt new technologies, seek resources to achieve a goal, increase farm operations, and take advantage of or seize available business opportunities.

Table 12: Factors influencing agricultural entrepreneurship: Two-step estimation of the generalized regression model result

Entrepreneurship	**Coefficient**	**Std. err.**	**z**	**P-value**
Entrepreneurial spirit	0.260	0.057	4.570	**0.000*****
Entrepreneurial attitude	0.190	0.072	2.630	**0.009*****
Farming interest	0.129	0.056	2.300	**0.021****
Market access	0.032	0.043	0.740	0.459
Gender	-0.104	0.061	-1.700	**0.089***
Age	0.001	0.003	0.370	0.714
Education	0.059	0.030	1.920	**0.054***
Marital Status	0.009	0.022	0.380	0.702
Extension officer	0.084	0.071	1.180	0.238
Access to credit	-0.043	0.066	-0.660	0.508
Agricultural Cooperative	0.055	0.073	0.750	0.451
Household Size	-0.016	0.015	-1.010	0.310
Farm information	0.034	0.019	1.750	**0.080***
Sell produce (market participation)	0.187	0.085	2.210	**0.027****
Input distance	-0.012	0.008	-1.660	**0.098***
Constant	1.154	0.488	2.370	0.018
ENT_SPIRIT_01	-0.792	0.350	-2.270	**0.023****
Constant	0.254	1.348	0.190	0.850

****** p<0.01, ** p<0.05, * p<0.1***

The result in Table 12 shows that the coefficient of entrepreneurial attitude had a positive and significant effect (1% level) on agricultural entrepreneurship among smallholder farmers. The result depicts that a positive attitude towards agricultural entrepreneurship increases the probability of participating in agricultural entrepreneurship endeavors among smallholder urban vegetable farmers. This could be attributed to the fact that a positive entrepreneurial attitude can improve entrepreneurial behavior towards innovative agricultural entrepreneurial endeavors. The result of this study substantiates the findings of Rosairo and Potts (2016), who in their study found that positive attitudes towards innovation increase entrepreneurial behavior as farmers tend to adopt new crop varieties, inputs, and new farming and value-addition methods. Furthermore, the study of Tambwe et al (2020) found that attitudes towards

entrepreneurship were positive and a significant factor in the development of entrepreneurial intention among farmers.

The result in Table 12 shows that the coefficient of farming interest had a positive and significant effect (5% level) on agricultural entrepreneurship among smallholder farmers. The result depicts that as farming interest is increased the probability of engaging in agricultural entrepreneurship ventures is also increased. This could be attributed to the fact that farmers who have a farming interest will be actively involved in farming practices and will seek markets where they can sell their commodities in order to generate income. According to Kopiyawattage et al (2019), urban farmers are influenced by favorable attitudes, subjective norm perceptions, and a sense of having sufficient behavioral control when deciding whether to continue growing in urban areas and urban farmers are more supportive of ongoing urban farming when they believe that urban food production is advantageous and aligns with current institutions and values.

The coefficient of gender of the household head had a negative and significant effect (10% level) on agricultural entrepreneurship among the smallholder urban vegetable farmers. The result depicts that female-headed vegetable farmers are more involved in agricultural entrepreneurial activities than their male counterparts. This could be attributed to the fact that in urban areas, female smallholder farmers tend to engage in agricultural entrepreneurial endeavors more than compared to their male counterparts as males tend to be employed in the industrial sector in urban settings. The findings of this study are consistent with the study of Mkandawire et al (2023) who found that women outnumber men in terms of engaging in agribusiness in urban and peri-urban areas. Consequently, males often end up having lower aspirations in farming activities in urban settings.

The result in Table 12 shows that education had a positive and significant effect (10% level) on agricultural entrepreneurship among smallholder urban vegetable farmers. The result depicts that as education is increased the probability of engaging in agricultural entrepreneurship endeavors is also increased among smallholder urban vegetable farmers. This could be attributed to the fact that education can improve farmer skills and agricultural knowledge that can assist farmers to be successful in agricultural entrepreneurship endeavors. The result of this study is consistent with the findings of Arafat et al (2020), who found a positive relationship between education and agricultural entrepreneurship as they explain that farmers who are educated are confident in their knowledge and skills and are likely to engage

in agricultural entrepreneurship. The study by Zaca et al (2021) found that education is positively associated with agricultural entrepreneurship.

The coefficient of access to farm information (Farminfo) has a positive and significant effect (10% level) on agricultural entrepreneurship among the smallholder urban vegetable farmers. The result depicts that an increase in access to farm information increases the probability of engaging in agricultural entrepreneurship endeavors among smallholder urban vegetable farmers. This could be attributed to the fact that having access to farm information opens farmers to various farming and market opportunities which can enhance their entrepreneurial intentions and endeavors. The result of this study is consistent with the findings of Rosairo and Potts (2016) who posited that respondents who own mobile phones used them to access information on crop diversification, farming, and market information.

The result in Table 12 shows that market participation (Sellproduce) has a positive and significant effect (5% level) on agricultural entrepreneurship among smallholder urban vegetable farmers. The result shows that market participation increases the probability of engaging in agricultural entrepreneurship activities among smallholder urban vegetable farmers. This could be attributed to the fact that the participation of farmers in the market can improve their farm income. This finding resonates with the study of Aku et al (2018) who found a positive significant relationship between market access and farm income. Smallholder urban farmers are located closer to the markets since their farming plots are located near the cities and fresh produce markets. In the same vein, the study of Mariyono (2018) posited that farmers who are located far from the market are less likely to engage in commercial farming activities as the distance to the market represents cost-effective and efficient transportation for selling produce. Furthermore, the study of Wale et al (2021) found that market access has a positive effect on smallholder farmers' entrepreneurial behaviour.

The result in Table 12 shows the distance to input suppliers (Inputdistance) had a negative and significant effect (10%) on agricultural entrepreneurship among the smallholder urban vegetable farmers. The result reveals that an increase in the distance to input suppliers decreases the probability of engaging in agricultural entrepreneurial endeavors among smallholder urban vegetable farmers. This could be attributed to the fact that farmers will be discouraged from engaging in agricultural entrepreneurship endeavors if the input suppliers are further away from the farming plots. This result is similar to the result of Pangbourne and Roberts (2015) whose result confirmed the importance of context with a far higher proportion

of farmers carrying out transactions with their local businesses than suggested by the distance-based measures.

5.5 Chapter Summary

Urban farming and agricultural entrepreneurship endeavors have been recognized as important instrument for creating employment opportunities, alleviating poverty, and contributing to food and nutrition among smallholder urban farmers. This study aimed to identify the factors that influence agricultural entrepreneurship among smallholder urban vegetable farmers in the Sobantu and Mphophomeni township areas. The two-step estimation of the generalized regression model result indicated that agricultural entrepreneurship was significantly influenced by entrepreneurial spirit, entrepreneurial attitude, farming interest, gender, education, farming information, selling produce, and the distance to input suppliers. The study concludes that the identified significant variables are the main drivers of agricultural entrepreneurship among smallholder urban vegetable farmers in the study areas. Furthermore, agricultural entrepreneurship can be enhanced in urban settings through the improvement of farming information and empowerment of urban farmers to improve entrepreneurial spirit, entrepreneurial attitude, and farming interest among vegetable farmers. The study recommends urban policies and programs that strengthen farming and market information sources and entrepreneurship training activities to improve agricultural entrepreneurship endeavors among smallholder urban farmers. The study also recommends that urban dwellers receive formal education and training from government and non-government organizations. Furthermore, locating input suppliers close to the urban farmers' farming plots can improve entrepreneurial activities.

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Chapter 6: The role of water security and market access on entrepreneurial engagement among smallholder urban vegetable farmers in KwaZulu-Natal Province: A structural equation modeling approach

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Abstract

Entrepreneurial engagement is critical for the development of smallholder farmers, yet the factors driving entrepreneurial endeavors remain underexplored, particularly in resource-constrained settings. This study investigates the relationship between water access, market access, and entrepreneurial engagement among smallholder urban vegetable farmers in KwaZulu-Natal Province, South Africa, using a Structural Equation Modelling (SEM) approach. Drawing on 156 farmer responses, the study examines key factors such as market access and water security and their impact on entrepreneurial activities. The results reveal a significant inverse relationship between water security and entrepreneurial engagement, suggesting that higher water security may reduce the motivation for risk-taking and innovation among farmers. Conversely, market access did not have a statistically significant influence. These findings challenge conventional assumptions and highlight the need to consider local barriers beyond resource availability, such as market conditions and institutional support. The study contributes to the understanding of the complex dynamics influencing entrepreneurship in the agricultural sector and suggests policy interventions to address non-resource-related constraints on entrepreneurial growth.

Key words: Water security, entrepreneurial engagement, market access, smallholder farmer

6.1 Introduction to the research problem

6.1.1 Global state of entrepreneurship among smallholder farmers and its determinants.

Entrepreneurial engagement among smallholder farmers has emerged as a vital aspect of rural development, poverty reduction, and food security (Dzingirai, 2021). Smallholder farmers, who constitute a significant portion of the global agricultural workforce, are increasingly adopting entrepreneurial approaches to increase their productivity, diversify income streams, and improve their livelihoods (Azamat et al., 2023). However, the level of entrepreneurial endeavor varies widely across regions, influenced by factors such as access to resources, market conditions, policy support, and individual characteristics. Entrepreneurial engagement among small-scale farmers is characterized by their shift from subsistence farming to market- oriented production and the diversification of income-generating activities (Azamat et al., 2023). In many regions, smallholder farmers are no longer solely focused on producing food for household consumption; they increasingly engage in agribusinesses, value-added activities, and the commercialization of agricultural products. This trend reflects the growing recognition of farming as a business, where innovation, risk-taking, and strategic decision-making are essential components (Naminse & Zhuang, 2018).

In developed countries, such as the United States and European nations, smallholder farmers are often well-integrated into markets and benefit from technological advancements, financial resources, and government policies that encourage entrepreneurship (Pindado & Sánchez, 2017). These farmers frequently engage in diversified ventures, such as organic farming, agritourism, and artisanal food production. For instance, farmers in Europe have embraced niche markets like organic produce, which allows them to command premium prices and improve their profitability (Pindado & Sánchez, 2017). On the other hand, in developing regions like Sub-Saharan Africa, South Asia, and parts of Latin America, smallholder farmers face a more complex environment (Nagler & Naudé, 2017a). While entrepreneurship is recognized as a pathway out of poverty, these farmers often encounter significant constraints that limit their entrepreneurial potential. Factors such as limited access to finance, inadequate infrastructure, fluctuating market prices, and a lack of technical skills hinder their ability to transition from subsistence farming to commercially viable agribusinesses (Pato & Teixeira, 2016).

A primary determinant of entrepreneurial endeavor among smallholder farmers is their access to key resources, including land, capital, labour, and technology. Farmers with access to sufficient resources are better positioned to invest in high-yield crops, irrigation systems,

mechanization, and modern inputs like fertilizers and pesticides (Nagler & Naudé, 2017a; Pato & Teixeira, 2016). The Resource-Based View (RBV) theory posits that the availability of unique resources, including human, financial, and physical assets, provides a competitive advantage to entrepreneurs, including farmers (Tate & Bals, 2018). However, resource constraints remain a critical issue for smallholder farmers, particularly in developing countries (Nagler & Naudé, 2017a). Access to finance is often limited, with many farmers unable to secure loans from formal financial institutions due to a lack of collateral, credit history, or banking infrastructure. Microfinance institutions and cooperative models have attempted to fill this gap, providing small loans and financial services to marginalized farmers. Furthermore, the emergence of digital platforms and mobile banking solutions has facilitated greater financial inclusion, allowing farmers to engage in entrepreneurial activities (Dias et al., 2019; Karimi et al., 2017; Ntshangase et al., 2018).

Market access plays a significant role in determining entrepreneurial engagement. Farmers who have reliable access to markets are more likely to commercialize their agricultural activities and seek out opportunities to innovate (Karimi et al., 2017). However, smallholder farmers often struggle with integrating into larger value chains due to poor infrastructure, limited information about market prices, and the presence of middlemen who reduce profit margins. To address these challenges, cooperatives and farmer associations have proven to be effective mechanisms for collective bargaining, reducing transaction costs, and improving market linkages (Karimi et al., 2017). These organizations enable smallholder farmers to pool resources, share information, and negotiate better prices for their products. Beyond this, modern technologies, such as mobile-based agricultural platforms, provide farmers with real-time information on market prices, weather forecasts, and access to buyers, enhancing their entrepreneurial capabilities (Lowder et al., 2016).

Entrepreneurial endeavor is often determined by the farmer's human capital, including education, knowledge, and technical skills (Karimi et al., 2017). Smallholder farmers who are better educated and have access to training in modern farming practices are more likely to adopt innovative techniques, improve productivity, and engage in value-added activities. Extension services, vocational training, and mentorship programmes are critical in building the entrepreneurial capacity of farmers (Karimi et al., 2017). However, in many rural areas, the availability of extension services is limited, and traditional farming methods remain predominant. To foster entrepreneurial growth, governments, and development organizations must invest in agricultural education and training programmes that equip farmers with the skills

needed to manage agribusinesses, navigate markets, and adopt sustainable farming practices (Karimi et al., 2017).

Governments in countries like Brazil and China have implemented policies aimed at enhancing rural entrepreneurship, offering financial support and infrastructure development for smallholder farmers (Soluk et al., 2021; Yin et al., 2022). In contrast, many African countries face challenges in creating enabling environments for agricultural entrepreneurship due to political instability, bureaucratic inefficiencies, and underinvestment in rural infrastructure. Social norms and cultural factors also influence entrepreneurial behavior among smallholder farmers (Soluk et al., 2021). In some regions, farming is viewed as a traditional occupation, with less emphasis on innovation and entrepreneurship. However, the perception of farming as a business is gradually changing, especially among younger generations who are more open to adopting new technologies and exploring alternative income streams (Morris et al., 2017).

6.1.2 Entrepreneurial activity among smallholder farmers in KwaZulu Natal

Entrepreneurship is increasingly seen as a vital avenue for economic growth and poverty alleviation, particularly in rural and semi-rural communities (Dias et al., 2019). In KwaZulu Natal, a province in South Africa with a rich agricultural history, smallholder farmers play an important role in both food production and rural development. However, despite the potential benefits of entrepreneurship, smallholder farmers in this region face numerous challenges that hinder their ability to fully engage in entrepreneurial endeavors (Ntshangase et al., 2018). The empirical literature highlights several challenges including, limited access to finance, inadequate infrastructure, limited market access, limited access to technology, skills deficit, and lack of training and land tenure and ownership issues (Sinyolo et al., 2017).

A significant challenge faced by smallholder farmers in KwaZulu Natal is the lack of access to affordable and adequate financing (Sinyolo et al., 2017). Many smallholder farmers do not have the collateral or credit history required by formal financial institutions, making it difficult to secure loans for investment in their agricultural businesses. As a result, they are often unable to purchase high-quality inputs such as seeds, fertilizers, and farming equipment, which are necessary for improving productivity and expanding operations (Sitharam & Hoque, 2016). Moreover, the microfinance sector, though present, often charges high interest rates, which further discourages small-scale farmers from borrowing. The lack of financial inclusion limits entrepreneurial opportunities and forces farmers to rely on subsistence-level farming, which

provides only minimal income and leaves little room for risk-taking or innovation (Sitharam & Hoque, 2016).

The state of infrastructure in rural KwaZulu Natal poses a significant barrier to entrepreneurial success for smallholder farmers. Poor road networks, unreliable transportation systems, and a lack of storage facilities make it difficult for farmers to access markets and sell their produce in a timely and cost-effective manner (Nagler & Naudé, 2017b). In many cases, farmers are forced to sell their goods to local middlemen at lower prices because they lack the means to transport their products to larger, more profitable markets. Furthermore, the lack of cold storage facilities and reliable electricity exacerbates post-harvest losses, especially for perishable crops like fruits and vegetables. This reduces farmers' incomes and undermines their ability to engage in entrepreneurial activities that could add value to their produce, such as processing or packaging (Khapayi & Celliers, 2016).

While KwaZulu Natal's agricultural potential is high, many smallholder farmers struggle with limited market access. They are often disconnected from formal markets and rely on informal or local trading, where demand is low, and prices are unpredictable (Dias et al., 2019). In addition to transportation challenges, a lack of knowledge about market requirements and standards also hampers farmers' ability to engage in competitive agribusiness (Khapayi & Celliers, 2016). In addition to this, smallholder farmers often have limited access to market information, such as current market prices and consumer demand trends, which would allow them to make informed decisions about what crops to plant and when to sell. This lack of information leads to market inefficiencies, with farmers sometimes overproducing low-demand crops or selling produce at uncompetitive prices (Khapayi & Celliers, 2016).

Technological innovation is a key driver of agricultural productivity and entrepreneurial success. However, many smallholder farmers in KwaZulu Natal face challenges in adopting modern farming technologies. This is due to a combination of factors, including high costs, lack of technical knowledge, and insufficient support services (Morris et al., 2017). Without access to technology such as mechanized farming equipment, irrigation systems, and mobile platforms for market access, farmers are often stuck with traditional, labour-intensive practices that limit productivity and profitability (Morris et al., 2017). Moreover, smallholder farmers have limited access to information and communication technologies (ICTs), which could help them access better market opportunities, receive training on modern farming techniques, and manage their businesses more efficiently. The digital divide further widens the gap between

large commercial farms and smallholder farmers, putting the latter at a disadvantage in an increasingly technology-driven agricultural landscape (Morris et al., 2017).

Entrepreneurial success requires a combination of technical farming skills and business acumen. However, many smallholder farmers in KwaZulu Natal lack access to training and extension services that would enable them to develop the skills necessary for managing a successful agribusiness (Senyolo et al., 2018). The focus of agricultural extension services in the region has traditionally been on basic farming techniques, with less emphasis on business management, financial literacy, and marketing. Farmers who lack business skills are often unable to develop long-term strategies for growing their enterprises, managing cash flow, or making informed decisions about investments (Senyolo et al., 2018). Furthermore, the lack of training in value addition and processing further limits their ability to diversify their income streams by entering new markets or producing higher-value products (Sitharam & Hoque, 2016).

Finally, In KwaZulu Natal, many small-scale farmers face uncertainties surrounding land ownership and tenure. In some cases, communal land ownership systems limit the ability of individual farmers to make long-term investments in their farms or use the land as collateral for loans (Yobe et al., 2019). Land reform policies in South Africa have also contributed to uncertainty, as the redistribution process has sometimes resulted in inefficient use of land or a lack of support for new farmers. Without secure land tenure, small-scale farmers are less likely to invest in improvements to their farms, such as irrigation systems, soil conservation measures, or farm buildings, all of which are essential for entrepreneurial development (Yobe et al., 2019). Furthermore, insecure land tenure can result in disputes over land use and access, further complicating the efforts of farmers to establish and grow their businesses. KwaZulu Natal's smallholder farmers are particularly vulnerable to environmental challenges, such as climate variability, water scarcity, and soil degradation (Senyolo et al., 2018).

Climate change has made rainfall patterns more unpredictable, leading to periods of drought followed by flooding, which can destroy crops and reduce yields. Farmers who rely on rain-fed agriculture are especially vulnerable to these shifts in climate, which undermine their ability to plan for the future and engage in entrepreneurial activities (Jayne et al., 2019). Environmental challenges become even more aggravating for successful smallholder farming when farmers cannot make decisions on land management due to uncertainties in land ownership patterns. In addition, poor soil quality and the overuse of land have led to declining

agricultural productivity in many parts of the province. The costs of implementing sustainable farming practices, such as organic farming, agroforestry, or soil conservation techniques, are often too high for small-scale farmers without external support, leaving them trapped in a cycle of low yields and low incomes (Jayne et al., 2019; Ntshangase et al., 2018).

6.1.3 The research question and objective

Entrepreneurship is a critical driver of economic development and poverty alleviation, especially within the agricultural sector (Naminse & Zhuang, 2018). In KwaZulu Natal Province, smallholder urban farmers represent a crucial group whose entrepreneurial endeavors hold the potential to enhance food security, generate income, and contribute to local economies (Maziya et al., 2017; Shisanya & Mafongoya, 2016). The present research aims to investigate the factors influencing entrepreneurial engagement among these farmers. This research can offer solutions to some of the key challenges faced by smallholder farmers, while also contributing to the broader body of research on agricultural entrepreneurship. The research topic focuses on identifying the key variables that influence smallholder urban farmers' decisions to engage in entrepreneurial activities. Through the application of Structural Equation Modelling (SEM), a statistical technique that allows for the analysis of complex relationships between multiple variables, this study aims to provide a detailed understanding of the interplay between these factors and entrepreneurial behaviour.

The focus on smallholder urban vegetable farmers is significant because, unlike their rural counterparts, urban farmers face unique challenges, including limited land, market competition, and regulatory restrictions (Maziya et al., 2017a). By investigating the determinants of entrepreneurship, this research seeks to address specific barriers, such as access to resources, market information, and skills development, while identifying opportunities for fostering sustainable agribusiness among urban farmers (Maziya et al., 2017). Through the SEM, the research explores how these barriers interconnect and influence entrepreneurial behaviour. This provides evidence-based recommendations to policymakers, NGOs, and private sector actors about interventions that would enhance access to credit, land tenure security, and affordable technology. Ultimately, addressing these barriers helps smallholder urban farmers transition from subsistence farming to more profitable, market-oriented agricultural ventures.

Much of the existing research on smallholder farming focuses on rural farmers, with comparatively little attention paid to urban farming. By focusing on smallholder urban farmers,

this research fills an important gap, as urban farmers face unique challenges and opportunities distinct from their rural counterparts (Lowder et al., 2016; Sitharam & Hoque, 2016). These findings could be extrapolated to other urban farming contexts, both within South Africa and globally, where smallholder farmers operate in densely populated environments with limited land and market competition. Methodologically, while SEM is widely used in social sciences, its application in agricultural entrepreneurship, especially among smallholder farmers, is relatively underexplored. This study's use of SEM to model the relationships between multiple determinants of entrepreneurial engagement introduces a sophisticated quantitative approach that allows for a more detailed understanding of the factors driving entrepreneurship. By establishing causal relationships, the research can provide important evidence for policy interventions and development programmes. The insights gained from this research will have practical implications for agricultural development policies in KwaZulu Natal and beyond. By identifying the key determinants of entrepreneurial success, the study will guide policymakers, development agencies, and local governments in designing programmes that effectively support smallholder urban farmers. This may include reforms to land tenure systems, improved access to credit, or capacity-building initiatives to develop entrepreneurial skills.

6. 2 Theoretical Framework

Entrepreneurial activities play a critical role in the development of smallholder urban farmers, particularly in regions like KwaZulu Natal Province, South Africa. However, understanding the determinants of entrepreneurial engagement requires a comprehensive framework that captures the cognitive and social factors influencing individual behaviors. One such framework is the Theory of Planned Behaviour (TPB), developed by Icek Ajzen in 1985 (Ajzen & Fishbein, 1988). This theory provides insights into how farmers' intentions and behaviors are shaped by their attitudes, social norms, and perceived control over their entrepreneurial activities (Ajzen, 2020). The TPB postulates that individual behavior is guided by behavioral intentions, which are determined by three key factors: attitude toward the behavior, subjective norms, and perceived behavioral control. These three components form the basis of the theory and provide a structured way to examine how individuals make decisions about engaging in specific behaviors, such as entrepreneurship (Ajzen, 2020).

The first core concept of the TPB is the attitude toward the behavior, which refers to an individual's evaluation of the behavior as favorable or unfavorable. This attitude is shaped by beliefs about the potential outcomes of the behavior (Ajzen & Fishbein, 1988). In the context of smallholder urban farmers in KwaZulu Natal, attitude toward entrepreneurship might

include factors such as economic factors and perceived risks. The development of farmers' entrepreneurial behavior is significantly influenced by entrepreneurial psychological capital (Zhao et al., 2020). According to certain research, farmers' entrepreneurial activity is impacted by entrepreneurial psychological capital in a synergistic and integrative way (de Lima et al., 2020). Furthermore, compared to social capital, it has a more notable impact on how entrepreneurs view their business environment and possibilities (Yalap et al., 2020). Positive entrepreneurial psychological capital is a key component of entrepreneurial sustainability.

Economic benefits accrue from the belief that starting an agribusiness will lead to increased income, financial stability, or improved quality of life. Perceived risks arise from concerns about the financial risks associated with entrepreneurship, such as potential failure or the uncertainty of agricultural markets. Farmers who have a positive attitude toward entrepreneurship are more likely to intend to engage in entrepreneurial endeavors, whereas those with negative perceptions may be discouraged from taking such actions.

Subjective norms refer to the perceived social pressures that influence an individual's decision to engage in or avoid a particular behavior. These norms are shaped by the opinions of significant others, such as family, friends, peers, or community leaders (Senger et al., 2017). For smallholder urban farmers, subjective norms might include community expectations and support from family and peers. Community expectations imply that farmers may feel pressure to conform to traditional farming practices, especially in communities where entrepreneurship is viewed with skepticism. If smallholder urban farmers perceive that their social network supports their entrepreneurial aspirations, they are more likely to form positive intentions to engage in such endeavors. Conversely, if they face opposition or lack of support, their entrepreneurial intentions may weaken.

Perceived behavioral control is a critical component of the TPB, referring to the perceived ease or difficulty of performing a behavior based on available resources and abilities. This concept is similar to the idea of self-efficacy, which reflects an individual’s belief in their capability to execute actions that achieve specific goals (Senger et al., 2017). In the context of smallholder urban farmers, perceived behavioral control may be influenced by factors such as access to resources knowledge, and skills. Concerning access to resources, farmers' perceptions of their access to land, technology, capital, and information may determine their confidence in pursuing entrepreneurial ventures. Knowledge and skills influence the degree to which farmers believe they possess the necessary entrepreneurial skills, such as marketing, financial management,

and innovation, which can affect their likelihood of engaging in entrepreneurial behavior. Farmers with high perceived behavioral control are more likely to believe they can overcome challenges and successfully start or expand their agribusiness. Conversely, those who perceive significant barriers may be less likely to pursue entrepreneurial activities.

By applying the TPB, in the present research we can systematically explore how each of the three components—attitude, subjective norms, and perceived behavioral control—contribute to entrepreneurial action among small-scale urban farmers. This can be particularly useful for identifying both the motivations and barriers that shape farmers' decisions to engage in entrepreneurial activities. In assessing attitudes towards entrepreneurship, the farmers' beliefs about the benefits and challenges of engaging in entrepreneurial activities were explored which included, risk preference, problem-solving attitude, market opportunities, innovativeness, competitiveness, control, and change. These attributes enabled an analysis of farmers' perceptions of economic and social rewards of entrepreneurship, concerns about risks and uncertainties associated with commencing a business, and whether the farmers viewed entrepreneurship as a viable path to improving their livelihoods.

We also focused on perceived behavioural control examining factors that farmers perceived as affecting their capacity to engage in entrepreneurship. Exploring perceptions of access to critical resources and markets, we aimed to assess to what extent these factors influenced entrepreneurial engagement. Thus, in measuring perceived behavioral control, we focused on farmers' perceptions of the resources and skills they possess or lack to engage in entrepreneurial activities and their confidence in overcoming challenges such as access to markets, financing, or technology. Finally, in this strand, we examined the role of external factors such as government support programmes, and access to training in improving the farmers' sense of control. The study is of the assumption that understanding how perceived behavioural control influences entrepreneurial intentions allows the present research to recommend capacity-building initiatives such as entrepreneurial training, access to financial services, or improved agriculture extension services that empower farmers to act on their entrepreneurial ambitions. The application of TPB in this research has practical implications for both policy and practice. By identifying the determinants of entrepreneurial behavior, the study can inform the development of targeted interventions to promote entrepreneurship among smallholder urban farmers in KwaZulu Natal.

6.5 Methods & Research setting

6.5.1 Description of Study Area (s)

The study areas for this study were Sobantu and Mphophomeni Township. Sobantu Township is located in Pitermaritzburg and Mphophomeni Township is located closer to Howick in KwaZulu-Natal. The Sobantu area compromises of industrial industries, formal and informal residential areas. Many of the informal residential areas are located on the floodplain of the rivers and the floodplain is utilized for agricultural purposes and other various activities. According to Mudhara et al (2014), in Sobantu, 28% of the farmers practice individual farming on community-owned land while 13.3% are involved in cooperative farming, 10.7% are in community farming, and 48% farm in their home gardens. In the Mphophomeni area, it appears that the demand for housing has increased along with population expansion, while the supply of housing has not kept up (Makwanduze., 2013). Although there are some unpaved roads in the township, there is good access to water and power. Nonetheless, certain areas of the community continue to rely on communal taps. Marketed as a component of the "Zulu tourism experience," Mpophomeni sits near the Midmar Dam and is encircled by waterfalls (Mathambo and Richter, 2007).

6.5.2 Research Design Description

In conducting this research, we adopted a quantitative design approach, specifically a survey of a sample of smallholder urban farmers to map their characteristics and the hypothesized factors that influence their entrepreneurial engagement. A quantitative approach is suitable because it allows for the collection of numerical data, which can be analyzed to examine relationships between variables, test hypotheses, and draw generalizable conclusions (Avkiran & Ringle, 2018). This design focuses on understanding how key factors, based on the Theory of Planned Behaviour (TPB) (Ajzen, 2020), influence entrepreneurial intentions and actions among smallholder urban vegetable farmers. The use of survey questionnaires as a data collection tool ensures a structured and standardized approach enhances the reliability and validity of the findings (Creswell & Creswell, 2017).

The quantitative research approach focuses on testing the hypothesized relationships between the variables of interest using numerical data. This method is appropriate for this study as it allows for the measurement of latent variables (attitudes, norms, perceived behavioral control, intention, behavior) through observable survey items. Furthermore, statistical analysis, particularly Structural Equation Modelling (SEM), to examine both direct and indirect relationships between the variables requires the use of structured quantitative data. Finally, a

quantitative approach enables the generalization of results to a larger population of smallholder urban farmers based on a representative sample (Creswell & Creswell, 2017).

6.5.3 Population, sampling and sample size

The target population for this study included smallholder urban farmers in Sobantu and Mphophomeni areas in KwaZulu Natal Province, South Africa. These farmers engage in various agricultural activities, such as crop cultivation, often on a small scale within urban and peri-urban settings. In sampling participants for this study, a sample size of 156 smallholder urban farmers was sampled in Sobantu (n=101) and Mphophomeni (n=55) Township using a multi-stage sampling technique. Multi-stage sampling is a complex form of cluster sampling in which two or more levels of units are embedded one in the other (Acharya et al., 2013). The first stage involved a purposive sampling technique based on the predominance of smallholder urban vegetable farmers in Sobantu and Mphophomeni. In the second stage, a proportionate random sampling technique was used to select vegetable farmers in the study areas. We utilized the sample size recommendations for SEM studies (Venturini & Mehmetoglu, 2019). We utilized a Partial Least Squares (PLS) SEM approach which enables the use of small sample sizes when compared to the covariance-based (SEM) approach which requires large sample sizes (Hair Jr et al., 2021).

6.5.4 Survey questionnaire design

The primary data collection tool for this study is a structured survey questionnaire. The questionnaire consists of several sections designed to measure both latent constructs from the TPB framework and socio-demographic variables. The questionnaire was designed to collect demographic information, attitudes toward entrepreneurship, entrepreneurial intention, and behavior, perceived behavioral control, and market and water access information.

6.5.5 Validity and Reliability

In ensuring construct validity, we calculated different metrics such as Cronbach alphas, composite reliability indices, polychoric correlations, and associated eigenvalue tests for matrices, sampling adequacy tests (Kaiser Meyer Olkin—KMO), and Bartlett's test for sufficient correlations among variables as prerequisites for factor analysis models (Hastie et al., 2013; Jin & Cao, 2018). We also ran other measures associated with the structural equation model, such as discriminant analysis, composite reliability measures, relative alpha, and measures of model fit to the data which evaluates the fit of the model used to the data sample. These are discussed in the modeling of the data and the discussion.

6.5.6 Structural Equation Modelling (SEM) approach

The Theory of Planned Behaviour (TPB) is widely used in research to predict and explain individual behavior based on three key determinants of attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 2020). These constructs interact to shape an individual's intention to engage in a specific behavior, which in turn drives actual behavior. To effectively capture these complex relationships, researchers often use Structural Equation Modelling (SEM). SEM is a powerful statistical technique that allows researchers to assess relationships between observed (measured) and latent (unobserved) variables, making it particularly suitable for testing behavioral theories like TPB (Gana & Broc, 2019). Structural Equation Modelling (SEM) is a comprehensive statistical approach that allows for the estimation of complex relationships between multiple variables. It integrates two main components, a measurement model which links latent variables (constructs) to manifest variables (indicators), and a structural model which links the relationship between constructs (Civelek, 2018). The measurement model specifies the relationships between observed variables (such as survey items) and latent constructs (such as attitudes, norms, or behavioral control). This involves conducting a confirmatory factor analysis (CFA) to test how well the observed variables measure the underlying theoretical constructs (Civelek, 2018). The structural model specifies the relationships among latent constructs. In the case of TPB, it represents how attitudes, subjective norms, and perceived behavioral control influence behavioral intentions and, ultimately, actual behavior. In applying the structural model in the present research, we focus on how perceived behavioral control (access to resources, markets, water, etc) predicts entrepreneurial engagement.

In this study on entrepreneurial endeavors among smallholder urban farmers, SEM will be used to examine how attitudes toward entrepreneurship, social norms, and perceived control impact entrepreneurial intentions and behaviors. In the first stage, SEM is used to create a measurement model that links observable data (collected through survey responses) to the latent TPB constructs:

- Attitude toward entrepreneurship: This is measured using items assessing farmers' positive or negative evaluations of entrepreneurship (e.g., beliefs about profitability or personal satisfaction, risk preference, and competitiveness).
- Subjective norms: Observable items can assess the influence of social expectations, such as perceived support or disapproval from family, friends, or community members regarding

entrepreneurial activities. In the present study, we used access to support systems (support) and conflicts as measures of subjective norms.

- Perceived behavioral control: This construct can be measured using items that assess farmers' perceptions of their capacity to engage in entrepreneurial activities, such as their confidence in securing resources, accessing markets, or overcoming challenges. In the present study, we used access to markets, and access to resources principally, water, land, and technology as important determinants of perceived behavioral control, with the target behavior being entrepreneurial engagement.
- Entrepreneurial intention: This latent construct is measured by assessing farmers' expressed desire or plan to start or expand an agribusiness. In conjunction with entrepreneurial intention is entrepreneurial behavior, which outcomes can be observed through actual entrepreneurial actions taken by the farmers, such as starting a new business, entering new markets, or adopting innovative agricultural techniques.

In this model, SEM will help test the following hypotheses:

- Farmers with positive attitudes toward entrepreneurship are more likely to have higher entrepreneurial intentions. Using latent constructs, we expect that farmers having higher scores on risk-related decisions, competitiveness, and so forth exhibit higher levels of positive attitudes towards entrepreneurial intention.
- Farmers who perceive strong social support (subjective norms) are more likely to have higher entrepreneurial intentions. Since social support and conflicts the key indicators used in measuring subjective norms were measured in the negative (lack of support, and conflict), higher values of the constructs measuring subjective norms would imply more evidence towards lack of support and conflicts while lower scores would indicate less influence of these factors on subjective norms.
- Farmers with high perceived behavioral control are more likely to develop strong entrepreneurial intentions. After running the structural model, we generated predictions for the endogenous construct measuring entrepreneurial intention and compared these across farmers' characteristics. Farmers with higher scores exhibit higher entrepreneurial intent when compared to farmers with lower scores.

In the study on the determinants of entrepreneurial engagement among smallholder urban vegetable farmers in KwaZulu Natal Province, SEM is a comprehensive methodology for

understanding the complex interactions between psychological, social, and behavioral factors that drive entrepreneurship. By applying SEM this study can identify the most significant determinants of entrepreneurial intention and behavior among smallholder urban farmers, which could include specific attitudes toward entrepreneurship, social influences, or perceived resource constraints. The study can test how farmers' attitudes, social norms, and perceptions of control interact to shape their entrepreneurial decisions. Furthermore, the study can explore whether these determinants vary across different demographic groups (e.g., based on education, gender, or experience), providing insights into targeted policy interventions to promote entrepreneurship. Finally, the study can generate a validated model that can be used to predict entrepreneurial behavior among smallholder farmers, contributing to the broader literature on agricultural entrepreneurship.

6.6 Data and Results

The data used in this study is a sub-set of variables extracted from a larger study investigating "market access and entrepreneurship and the role of water security in urban and peri-urban based farming in KwaZulu Natal". This data was collected using the survey questionnaire discussed above. This dataset contains 156 observations, which are cases of farmers responding to questions on their demographic characteristics, entrepreneurial factors, factors on market access, and access to water for farming. The key variables in this analysis are primarily the demographic variables, gender, age of the farmer, level of education, income source, membership in an agricultural cooperative, household size, and type of farming. In preparing the data for analysis, the variables were coded to maximise representation for statistical analysis. This included revising data with poorly represented levels to ensure that the data meets the minimum conditions for various tests, for example, chi-square tests (Chi2), which require that rows in contingency tables have a minimum of five (5) observations (Ibraheem and Mohammed, 2022). The gender variable measured as male and female was adjusted to a dichotomous scale with female (0) and male (1). The recorded age of the farmer is a discrete numeric variable with a minimum value of 20 years and a maximum value of 77 years. Concerning recorded levels of education, there were five categories captured during data collection. Of the 156 participants in the study, approximately 9% had some tertiary education, 44% some secondary education, 40% some primary education, and the remaining 8% were divided between 4% those with no formal education who could not read or write and the other 8% of those with no formal education but who could read and write.

The income source variable is a 6-level categorical variable containing various sources of income for farming. Of the recorded income sources, 16% came from farm income reinvested into the farming business, government grants comprised some 12% of income source, non- farm income comprised 13%, and old age pension comprised 40% (an interesting observation given the recorded age of participants in the sample predominantly), remittances comprised 6% and wages from formal employment comprised 13%. Finally, the variable assessing household size was considered due to the importance of household size among smallholder farmers in South Africa In two recent studies, household size was considered a key influence of strategies adopted among smallholder farmers in KwaZulu Natal (Maziya et al., 2017; Yobe et al., 2019). These variables were not used in derived latent variables during structural equation modelling and generation of latent scores, although they were used for group comparison using t-tests and analysis of variance (ANOVA) to determine whether the calculated weighted indices through structural equation modelling differed based on demographic characteristics. In section C of the questionnaire, entrepreneurship was measured using various items including risk preference, ability to seize market opportunities, proactivity, problem-solving ability, innovativeness, competitiveness, adaptability, perceived discipline, and good vision. These items were measured using the Likert scale, ranging from 1 “strongly disagree” to 5 “strongly agree”, and are categorical ordinal variables.

6.6.1 Factor analysis: Entrepreneurship, market factors and water access constructs

The following table shows the factor loading matrix for the determinants of market access.

Table (13): Factor Matrix for Attributes of Market Access

Variable	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	Uniquenes s
TOTINC	0.794						0.339					0.169
InputDist		0.679							0.500			0.161
OutputDist		0.851										0.137
TWNDIST		0.867										0.109
MKTINF	0.579								0.321		-0.453	0.122
MKTTYP1	-0.460							0.595				0.154
MKTTYP2	-0.410	-0.579		-0.435								0.098
MKTTYP3	0.806											0.124
MKTTYP4				0.870								0.067

Variable	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	Uniqueness
MKTTYP5								-0.660	-0.508			0.172
INFSRC1		0.533					0.615					0.054
INFSRC2	0.694							0.406				0.048
INFSRC3									0.855			0.065
INFSRC4	-0.301							-0.867				0.080
INFSRC5	-0.464	-0.340		-0.372					-0.471			0.081
INFSRC6			0.875									0.040
LNDOWN1	0.832											0.109
LNDOWN2		-0.438	-0.752									0.119
LNDOWN3	-0.373	0.554						0.496				0.074
LNDOWN4		0.320			-0.816							0.027
ValueAdd1			0.546					0.720				0.103
ValueAdd2								-0.854				0.077
ValueAdd4		0.807										0.032
ValueAdd5			-0.886									0.095
TRNSPRT1		0.783	0.314									0.109
TRNSPRT2	0.763						0.438					0.105
TRNSPRT3								-0.927				0.056
TRNSPRT4	-0.759							0.304				0.160
_LabourAccess		0.482	0.541					0.311				0.191
_Storage	0.592		0.324					-0.368	0.326			0.125
_Smartphone			0.845									0.139
_Markettraining	0.389		0.436	0.494				0.459				0.037

This results in the Table above presents and the results of the exploratory factor analysis (EFA) conducted on key variables related to market access, information sources, infrastructure, and value-adding activities. The objective of the analysis was to uncover latent structures that underlie observed variables, thereby informing a more balanced understanding of the multidimensional challenges and opportunities faced by participants in the economic system (e.g., smallholder

farmers, SMEs). A principal axis factoring method with rotation was used, and factor loadings with absolute values ≥ 0.30 were retained for interpretative purposes. Eleven distinct factors were extracted, explaining the majority of the variance in the dataset of 89.88%. The loadings and uniqueness values are shown in Table X. The factor analysis reveals a multidimensional structure underpinning economic behaviour and access among participants. Key latent constructs such as financial orientation, infrastructure access, digital adoption, and informal dependence emerge clearly.

Factor 1: Income and Market Orientation

Factor 1 is strongly defined by total income (TOTINC) and variables related to market type (MKTTYP3) and land ownership (LNDOWN1). This factor likely represents a dimension of economic capacity and formal market participation. The negative loadings of MKTTYP1 and MKTTYP2 suggest that individuals associated with informal or alternative markets load inversely on this factor. The positive loading of INFSRC2 (information from extension agents or formal sources) further reinforces this interpretation. Overall, Factor 1 captures financial orientation towards formal, structured markets.

Factor 2: Physical Distance and Access to Inputs and Outputs

Factor 2 is defined by high loadings on distance to input markets (InputDist), distance to output markets (OutputDist), and Transport infrastructure (TRNSPRT1). It captures the logistical constraints and physical accessibility issues that influence the movement of goods to and from the market. Notably, TWNDIST (distance to town) also loads highly on this factor, underscoring the geographical dimension of market access. This factor reflects spatial and infrastructural barriers.

Factor 3: Technology Usage and Digital Enablement

This factor shows strong associations with smartphone usage (Smartphone), digital platforms (INFSRC6), and market training (_Markettraining). The negative loading on ValueAdd5 might suggest a technological divide in the adoption of more advanced processing or marketing innovations. TRNSPRT1 and LabourAccess also load moderately here, suggesting a tech-enabled labour mobility and productivity-enhancing behaviour. Thus, this factor can be interpreted as Digital Readiness and Technology Adoption.

Factor 4: Market Typology and Institutional Linkages

Factor 4 is mainly defined by MKTTYP4, a variable associated with a specific market type, and _Markettraining, indicating exposure to training initiatives. MKTTYP2 and INFSRC5 load negatively, indicating alternative or informal market typologies. This factor likely captures the degree of institutional engagement in marketing systems, possibly reflecting whether the actor is

part of organised value chains.

Factor 5: Land Constraints and Value-Adding Limitations

This factor includes a strong negative loading from LNDOWN4 and a moderate loading from ValueAdd5, indicating that land tenure insecurity or lack of land resources might limit the ability to undertake value-adding activities. The presence of negative loadings suggests these variables move inversely with the latent construct, perhaps reflecting marginalisation in productive capacity.

Factor 6: Institutional Information and Value-Add Practices

Factor 6 is primarily defined by ValueAdd4 and TRNSPRT1, suggesting that value-adding and mobility are interlinked. INFSRC1 (formal information sources) also loads on this factor, suggesting that access to institutional knowledge may support business-enhancing activities. The factor reflects a cluster of institutional engagement and applied practices.

Factor 7: Multifaceted Productivity Support

Factor 7 reflects a mixed dimension with moderate positive loadings from TOTINC, TRNSPRT2, and Market-training, with negative loadings from MKTTYP2 and INFSRC5. This combination points to income-enhancing activities supported by reliable transport and capacity building, possibly offset by less use of informal information channels. This factor might be interpreted as Integrated Support for Market Productivity.

Factor 8: Informal Market Dependency and Risk Exposure

Factor 8 presents strong negative loadings on MKTTYP5 and INFSRC4, which may indicate informal markets or social-based information systems, potentially more susceptible to volatility. Market-training also loads here, suggesting some exposure to mitigation strategies. This factor may reflect dependency on informal systems with partial institutional outreach.

Factor 9: Social-Based Information and Disconnection from Formal Channels

Factor 9 is defined by strong positive loadings on INFSRC3 and Storage, and negative loadings on INFSRC5 and Market-typologies. These variables suggest reliance on community-based information or local knowledge, perhaps due to disconnection from mainstream institutional sources. This factor might reflect Social Embeddedness and Local Adaptation.

Factor 10: Transportation and Processing Constraints

Factor 10 includes negative loadings from TRNSPRT3 and moderate loadings from Storage and ValueAdd5, pointing toward infrastructure and logistics challenges. This could represent a latent constraint on operational expansion due to mobility and perishability issues.

Factor 11: Unobserved Variance and Minor Contributions

Factor 11 is defined by high loadings of INFSRC3 and InputDist with the rest being minimal loadings across the board. There is importance of information and access to inputs and likely

captures unique variance or noise, not systematically explained by other constructs. While it explains little shared variance, it may still reflect minor or highly context-specific patterns.

Measuring entrepreneurial characteristics and entrepreneurial indices

The entrepreneurial measures are observed variables from the data measuring various aspects of entrepreneurship, such as risk taking, identifying and improving economic opportunities, problem-solving, proactive approach to decision-making, independence, innovativeness, competitiveness, adaptability to change, locus of control and predictive focus. For methodological triangulation purposes , the attributes measuring risk were measured using principal components analysis as shown in Table 9. In this section, extending the analysis to evaluate structural and effect relationships, the structural equation modelling technique utilises confirmatory factor analysis (CFA). To this end, the same attributes were assessed using factor analysis with minimal differences, for PCA showed 4 components among which the attributes were distributed, while factor analysis showed three factor as presented in Table 13 below. Factors 1, 2 and 3 are the latent factors, which are linear combinations of the aggregated variables weighted by the associated loadings with the factor. These are the latent factors extracted from the data. Each factor represents a distinct underlying dimension of entrepreneurship. Variables with high loadings (e.g., >0.4) on a factor are strongly associated with it. Uniqueness represents the proportion of variance in each variable that is not explained by the factors. Lower uniqueness values indicate that the variable is well-explained by the factors, while higher values suggest more unique variance (less explained by the factors). The gaps "--" indicate that the factor loading is negligible or suppressed (typically <0.3 or not significant).

Table 14 below shows the factor loadings and the entrepreneurial measure.

Table 14: Factor loadings, Entrepreneurial factors.

Entrepreneurship Measure	Factor 1	Factor 2	Factor 3	Uniqueness
Risk-taking			0.5184	0.7304
Seize opportunities			0.8628	0.2245
Problem solving	0.5861	--	0.3806	0.4414
Proactive	0.8624	--	--	0.2072
Independent	0.7339	0.3219	--	0.3542
Innovativeness	0.5832	--	0.3197	0.5093
Competitive	0.6314	--	--	0.4611
Change	0.3268	0.5577	--	0.5657
Locus of control	0.3047	0.8326	--	0.1807
Good vision (Predictive focus)	--	0.8825	--	0.1961

The variables measuring entrepreneurial characteristics are distributed across three constructs,

factors 1, 2, and 3 as shown in table 13. We also printed the values of uniqueness on the table, which according to statistical theory should be below 0.6 (Velicer et al., 2000).

Factor 1: Entrepreneurial Drive and Self-Direction

Factor 1 is strongly associated with Proactive (0.8624), Independent (0.7339), Competitive (0.6314), Problem Solving (0.5861), and Innovative (0.5832). These traits describe individuals who take initiative, work autonomously, seek out challenges, and generate creative solutions — all of which are hallmark characteristics of entrepreneurial behaviour. This factor can be conceptualised as Entrepreneurial Drive and Self-Direction, representing the proactive, innovative, and achievement-oriented aspects of entrepreneurship. The relatively low uniqueness values for these items (e.g., Proactive: 0.21; Independent: 0.35) indicate that the factor explains a substantial proportion of variance in these variables.

Factor 2: Strategic Foresight and Control Orientation

Factor 2 shows high loadings on Good Vision (0.8825), Control (0.8326), and Embraces Change (0.5577), indicating a dimension related to visionary leadership, goal setting, and the ability to navigate uncertainty. Independent (0.3219) and Change (0.5577) also load moderately here, suggesting some overlap with traits from Factor 1 but capturing a distinct domain. This factor is labelled Strategic Foresight and Control Orientation — the cognitive and psychological ability to lead change, foresee future trends, and manage internal and external challenges effectively.

Factor 3: Risk-Taking and Opportunity Orientation

Factor 3 loads highly on Seize Opportunity (0.8628) and Risktaker (0.5184), and moderately on Problem Solving and Innovative, suggesting a unique dimension characterized by opportunism, risk tolerance, and a forward-looking mindset. This factor is interpreted as Risk-Taking and Opportunity Orientation, reflecting an individual's readiness to act in uncertain environments and capitalise on emerging opportunities. This factor is particularly relevant in volatile or resource-constrained entrepreneurial environments.

Some variables load on multiple factors: Risk-taking: Loads on Factor 1 (0.6821) and Factor 2 (0.5325). This suggests that risk-taking is a complex trait, associated with both proactive entrepreneurial behaviour (Factor 1) and a sense of control or vision (Factor 2). Independent: Loads on Factor 1 (0.7323) and Factor 2 (0.3321). Independence is primarily associated with proactive traits but also has a minor connection to control or vision. Problem solving: Loads on Factor 1 (0.6853) and Factor 3 (0.3495). This indicates that problem-solving is a multifaceted trait, contributing to both proactive behaviour and a distinct problem-

solving orientation. Variables with low uniqueness (e.g., Proactive: 0.2358, Locus of control: 0.1768) are well-explained by the factor model, meaning their variance is largely accounted for by the extracted factors. Variables with higher uniqueness (e.g., Innovativeness: 0.5145, Change: 0.4991) suggest that these traits have unique aspects not fully captured by the three factors. This could indicate the need for additional factors or that these traits are influenced by other unmeasured variables.

Empirical analysis

We wanted to also observe whether person-related demographic characteristics influence entrepreneurial endeavor, and to do this, we calculated factor scores for the three factors and calculated the distribution of these across demographic variables such as age categories, education levels, income source, and household size. These results are presented in Table 15 below.

Table 15: Scores of entrepreneurial factors over demographic characteristics.

Demographic Variable	Entre (F1)	Entre (F2)	Entre (F3)
Age (<= 30)	1.551 (3)	1.697 (3)	1.705 (3)
Age (<= 40)	0.953 (6)	2.042 (6)	1.674 (6)
Age (<= 50)	1.195 (24)	1.584 (24)	1.710 (24)
Age (<= 60)	1.252 (59)	1.612 (59)	1.539 (59)
Age (<= 70)	1.504 (63)	1.457 (63)	1.694 (63)
ANOVA (F, p-value)	1.07 (0.3711)	0.39 (0.8169)	0.25 (0.9087)
Education (None—can't read/write)	1.357 (6)	1.483 (6)	1.227 (6)
Education (None—Read/Write)	1.337 (6)	1.832 (6)	1.028 (6)
Education (Primary school)	1.265 (62)	1.381 (62)	1.774 (62)
Education (Secondary School)	1.446 (67)	1.702 (67)	1.536 (67)
Education (Tertiary school)	1.160 (14)	1.622 (14)	1.949 (14)
ANOVA (F, p-value)	0.45 (0.7734)	0.66 (0.6184)	1.84 (0.1244)
Income (Farm Income)	1.623 (25)	1.859 (25)	1.523 (25)
Income (Government grants)	1.005 (17)	1.267 (17)	1.669 (17)
Income (non-farm income)	1.336 (20)	1.833 (20)	1.383 (20)
Income (Old age pension)	1.439 (63)	1.384 (63)	1.754 (63)
Income (Remittances)	1.217 (10)	1.653 (10)	1.536 (10)
Income (Wages, formal employment)	1.024 (20)	1.692 (20)	1.687 (20)
ANOVA (F, p-value)	1.59 (0.1670)	1.04 (0.3938)	0.58 (0.7121)
Smaller Households	1.353 (67)	1.520 (67)	1.778 (67)
Medium sized households	1.301 (17)	1.785 (17)	1.973 (17)
Larger households	1.306 (23)	1.596 (23)	1.447 (23)
ANOVA (F, p-value)	0.03 (0.9682)	0.33 (.7227)	1.37 (0.2576)

In the table above, we wanted to assess whether the mean scores of the forms of entrepreneurial

endeavor among farmers were influenced by any demographic factors. The table shows the mean value of entrepreneurial characteristics and the number of participants over whom that particular mean is computed. The calculated factor scores were assessed over groups based on categories of demographic variables, age, income, education, and household size. The age variable confirms that young people make up a very small segment of the urban small-scale farmers with the majority being old-age farmers of at least 50 years old.

The majority of the farmers have at least some primary level education, with the lack of statistically significant differences as shown by the large p-values associated with the levels of education showing that education does not seem to be a significant differentiator of entrepreneurial endeavour among the farmers. We also observe that the entrepreneurial characteristics are mostly distributed among smaller households, although the differences are not statistically significant as shown by the large p-values associated with the ANOVA test. We also observe that most of the participants are older people on old age pensions, although we also observe other forms of income (farm income, non-farm income, government grants, and formal wage employment) have moderate representation. However, the income variable does not represent mutually exclusive categories, implying that individuals in the sample can have multiple income sources captured.

6.6.2 Water Access

Water access was measured at the household level based on the assumption that domestic water uses were intertwined with farm-level water uses. To this end, water access was measured using access to preferred water sources for the household, relative perception of limited access to water, reported lack of resources to obtain water, lack of enough drinking water, daily water rationing applicable, lack of drinking water due to no available resources to obtain water, whether any member went to sleep without water and whether the household went a day without drinking water. Using polychoric factor analysis, these variables were captured in a single latent construct accounting for 87.02% of the variation in water access in the original variables. We summarise the loadings on the construct in the table below.

Table 16: Water access construct

Water access measure	Factor loading	Uniqueness
Access to a preferred water source for household	0.8821	0.2220
Relative perception of limited access to water	0.9274	0.1400
Reported lack of resources to obtain water	0.9699	0.0593
Lack of enough drinking water	0.9081	0.1753
Daily water rationing applicable	0.8950	0.1990
Lack of drinking water due to no available resources to obtain water	0.8950	0.1990
Went to sleep without drinking water	0.9827	0.0342
Whether a household went a day without drinking water	0.9952	0.0095

The high loadings show the importance of these factors in determining water access. We created a composite variable of water access. Since our primary consideration is not water access, we did not assess it across farmers' demographic characteristics, although we utilized the information in structural equation modeling to investigate multiple predictors of entrepreneurial activity in grouped structural equation modeling.

6.6.3 Structural Equation Modeling

The SEM was guided by TPB and RBV to understand behavioral intention through latent constructs such as perceived control (water access) and enabling structures (market access). Robustness checks, including bootstrapping and multi-group analysis by gender and location, confirmed model stability. Covariance-based Structural Equation Modelling (CB-SEM) is a statistical technique used to analyze the structural relationships between measured variables (observed indicators) and latent variables (unobservable factors) (Hair Jr et al., 2021). It is a widely used method for

hypothesis testing and theory validation, particularly in fields like social sciences, psychology, and business research (Hair Jr et al., 2021). CB-SEM is preferred when the research objective is to test how well the data fits a theoretical model and to validate complex models involving multiple constructs and relationships. In this research study, we are using the Theory of Planned Behaviour (TPB) to investigate predictors of entrepreneurial engagement among smallholder urban farmers in KwaZulu Natal, to which CB-SEM is useful in helping to predict whether the theory is a better framework for understanding entrepreneurial engagement among small holder urban farmers. The key components of the CB-SEM model include observed/manifest variables, the constructs/latent variables, the measurement or confirmatory factor analysis

(CFA) model, and the structural model (which includes relationships among constructs. In CB-SEM, the covariance matrix of the observed variables is the primary input for model estimation. The goal is to reproduce this covariance matrix using the specified model structure, allowing researchers to assess the fit between the theoretical model and the empirical data (Gana & Broc, 2019). Using CB-SEM we ran a structural equation model to test the dynamic structural relationship between measures of entrepreneurial engagement and factors determining market and water access. The structural model included the measures of entrepreneurship presented in table 13, measures of market access discussed in table 12 and measures of water security in the confirmatory factor model. Structural relationships were mapped with market and water access latent variables predicting entrepreneurial activities. The latent variables entrepreneurial engagement (Ent), market access (Mkt), and water security (Watsec) represent underlying constructs measured by observable variables. Ent (Entrepreneurship) is measured by four indicators (Ent_1, Ent_2, Ent_3, Ent_5). Ent_1 measure problem solving, Entre_2 measures proactiveness, Entre_3 measures independence and Entre_5 measures competitiveness. We first present the measures of model fit associated with the model, the structural model diagram, and the regression table.

The structural equation diagram shown in Figure 7 is a summary of the structural equation results.

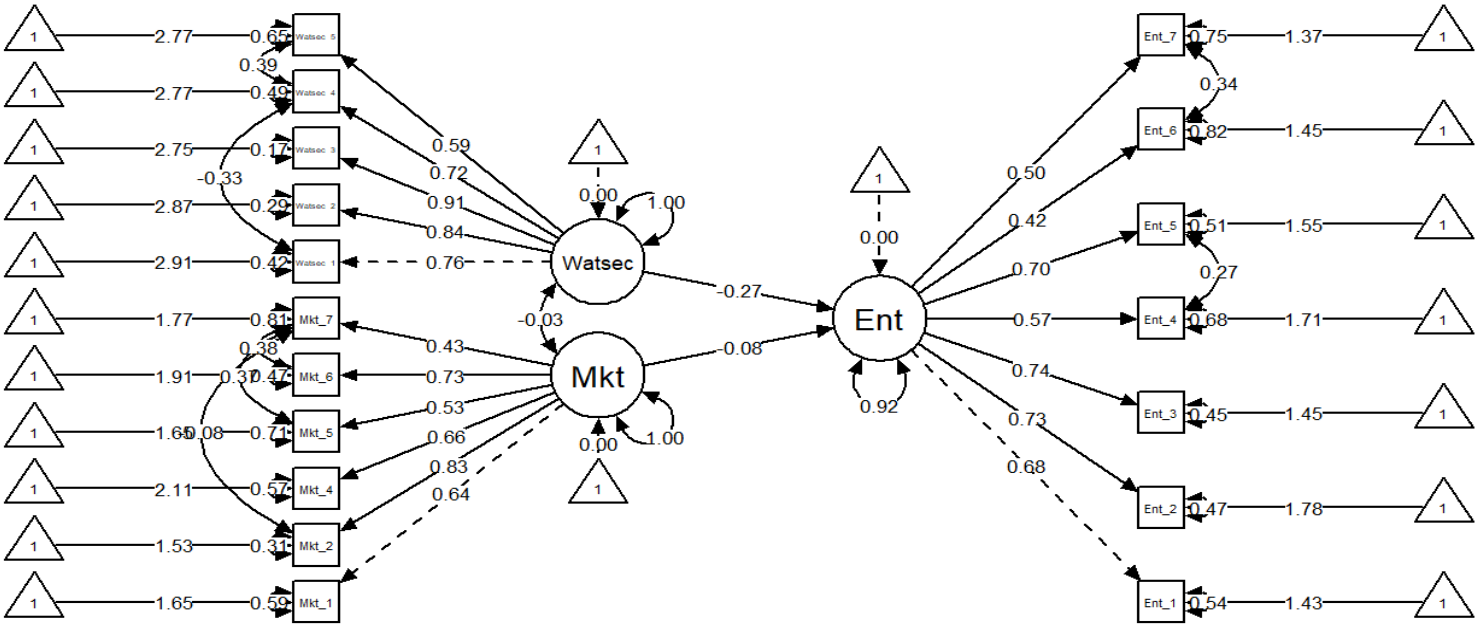

Figure 7: Structural equation model diagram

The model's fit statistics presented in table 16 can be summarised as excellent model's fit statistics, demonstrating that our data does fit the TPB which we utilized in interpreting motivations for entrepreneurial engagement among smallholder farmers in KwaZulu Natal. The model's chi-square (DF=38) is 32.260 with a p-value of 0.731. The p-value is non- significant ($p > 0.05$), which suggests that the model's fit is not significantly different from the data. This is a good outcome for model fit. The values for Comparative Fit Index (CFI = 1.000) and Tucker-Lewis Index (TLI = 1.013) are well above 0.90. Values above 0.95 indicate excellent fit. Both indices suggest that the model fits very well. The Root Mean Square Error of Approximation (RMSEA) is 0.000 indicating a perfect fit of the model to the data. An RMSEA value of 0 indicates a perfect fit. The confidence interval is [0.000, 0.043], and the p- value for the null hypothesis that RMSEA ≤ 0.05 is very high ($p = 0.975$), confirming an excellent fit. The value of the Standardized Root Mean Square Residual (SRMR) is 0.034. In general values below 0.08 are considered a good fit. The SRMR of 0.034 suggests a well-fitting model.

All loadings are significant ($p < 0.001$), and standardized loadings range from 0.659 to 0.755. These loadings suggest that the indicators strongly represent the latent construct. While originally, we used 10 indicators to measure entrepreneurial engagement (risk-taking, competitiveness, proactiveness, independence, seizing opportunities, innovativeness, locus of control, adaptability to change, good vision, and problem-solving), only four of these indicators were found to be statistically significant and retained for analysis under CB-SEM using a cut-off of standard loading of 0.65.

This may demonstrate that these are the indicators that map the nature of entrepreneurial engagement among smallholder farmers in the sample. Mkt (Marketing) is measured by three indicators (Mkt_2, Mkt_3, Mkt_6) from the original 11 indicators suggested by exploratory factor analysis (Table 1). The three retained indicators capture food prices (Mkt_2), insecure tenure (Mkt_3), and lack of support (Mkt_6). Loadings are significant ($p < 0.001$). However, the standardized loading for Mkt_3 (0.503) is weaker compared to Mkt_2 (0.870) and Mkt_6 (0.691), suggesting that Mkt_3 might not be as strong an indicator of the latent construct. Finally, the construct measuring water security (Watsec) is measured by four indicators (Watsec_1, Watsec_2, Watsec_3, Watsec_4). The four indicators capture access to preferred water sources for households (Watersec_1), relative perception of limited access to water (Watersec_1), reported lack of resources to obtain water (Watersec_3), and lack of enough drinking water (Watersec_4). All loadings are significant ($p < 0.001$), and the standardized loadings are high (ranging from 0.661 to 0.922), indicating a strong relationship between the observed variables and the latent variable.

In the structural equation diagram (Figure 7), we hypothesized that entrepreneurial engagement is influenced by perceived behavioral control (access to resources) and subjective norms (support and conflict). These were measured through access to water and access to markets. These relationships were captured in the structural model using the structural relationships in which latent constructs measuring water security and market access predict entrepreneurial engagement. The first regression relationship (Ent ~ Mkt (Estimate = -0.060, $p = 0.307$)) predicts entrepreneurial engagement using market access. The relationship between marketing (Mkt) and entrepreneurship (Ent) is negative but not statistically significant ($p > 0.05$),

implying no strong evidence that marketing directly affects entrepreneurship. In the second regression relationship, (Ent ~ Watsec (Estimate = -0.597, $p = 0.003$)), we predict entrepreneurial engagement using water security. The relationship between water security (Watsec) and entrepreneurship (Ent) is negative and statistically significant ($p < 0.01$). This suggests that higher water security leads to a decrease in entrepreneurship. The standardized effect size is moderate (-0.281). No significant covariances are reported among the residuals or between latent variables, which suggests that the model's residuals are relatively independent and that there is no strong unexplained covariance between latent factors.

The variances of the latent variables and their observed indicators are significant, which confirms that the variables have variability in the data. For example, the variance of Ent is 0.561, indicating a reasonable level of variability in this latent construct. The R-Square values represent the proportion of variance explained by the model for each observed variable. The variables Ent_1, Ent_2, Ent_3, and Ent_5 have R-Square values between 0.435 and 0.571, meaning the model explains 43-57% of the variance in these entrepreneurship indicators. The variable Watsec_3 has the highest R-Square value (0.849), meaning the model explains 85% of the variance in this indicator. Finally, Mkt_2 has a high R-Square of 0.757, while Mkt_3 has the lowest R-Square (0.253), meaning the model explains only 25% of the variance in Mkt_3, which might suggest it is a weaker indicator. The R-Square value associated with the Ent construct is 0.086, which implies that the statistically significant factor, water security, explains 8.6% of the variation of observed entrepreneurial engagement among smallholder farmers in KwaZulu-Natal.

Table 17: Measures of Structural Equation Model Fit

CB-SEM Model Measure of Fit	**Threshold**	**Model Indices**
Model Chi-Square Test (□2)	P > 0.05	0.731
Root Mean Square Error of Approximation (RMSEA): *Evaluates how well the model fits the population covariance matrix, correcting for model complexity.*	< = 0.05 "Excellent fit" 0.05 < RMSEA <= 0.08 "Acceptable fit"	0.0000
Standardized Root Mean Square Residual (SRMR): *Measures the difference between the observed and predicted correlations. A lower SRMR value indicates better fit.*	SRMR <= 0.08 "Acceptable fit" SRMR <= 0.05 "Good fit"	0.034
Comparative Fit Index (CFI); *Compares target to baseline model)*	CFI >= 0.95 "Excellent fit" CFI>= 0.9 "Acceptable fit"	1.000
Tucker Lewis Index (TLI): *Compares model's improvement over the null model yet penalises for model's complexity.*	TLI >=.95 "Excellent fit" TLI>=.90 "Acceptable fit"	1.019
Adjusted Good of Fit Index (AGFI):*Measures the proportion of accounted for by the estimated population covariance matrix.*	GFI >=.95 "Good fit" AGFI >=0.90 "Acceptable fit"	0.988

Normed Fit Index (NFI): *Compares fit of specified model to a null model.*	NFI >= .95 "Good fit" NFI>=0.90 "Acceptable fit"	0.953
Parsimony Normed Fit Index (PNFI): *A parsimony-adjusted version of NFI that penalizes for model complexity.*	PNFI >= 0.50 "Acceptable fit"	0.658

6.7 Discussion of Results

Water Security (Watsec) may relate to perceived behavioral control for entrepreneurial engagement, meaning that access to secure water resources provides entrepreneurs with a sense of greater control over their business operations, particularly in contexts reliant on agriculture or water-intensive processes. This control could lead to stronger engagement in entrepreneurial activities. Market Access (Mkt), which did not show a significant relationship with entrepreneurial engagement, might suggest that in this context, the perceived ease of reaching markets is not a primary factor influencing entrepreneurial behavior. This could point to other barriers or enablers being more critical to entrepreneurial engagement, such as financial constraints, infrastructure, or policy environment, not captured by market access alone.

Entrepreneurship and Water Security: Studies on entrepreneurship, particularly in rural or resource-constrained environments, highlight the critical role of water security in enabling business activities. Recent research in Sub-Saharan Africa shows that entrepreneurs engaged in agriculture or agro-processing sectors are highly influenced by water access as it directly affects their operational sustainability (Wale et al., 2021a). Secure access to water has been found to significantly affect entrepreneurial decisions and engagement, particularly in contexts where agriculture is a dominant economic activity.

Market Access and Entrepreneurship: While market access is typically considered crucial for entrepreneurial success, recent findings indicate that in many developing contexts, perceived access is not always enough to drive entrepreneurial engagement. Other factors, such as infrastructure challenges, policy barriers, and local demand, might outweigh the positive effects of market access. In cases where entrepreneurs do not feel supported by the broader market environment, the potential benefits of access may not translate into higher engagement. Research based on TPB shows that perceived behavioral control is often one of the strongest predictors of entrepreneurial intentions and behavior (Fellnhofer, 2017; Mahmoud et al., 2020). The findings align with this, as water security significantly impacts entrepreneurial engagement, suggesting that ensuring resources like water can enhance entrepreneurs' confidence in managing their businesses effectively.

The structural equation model supports the idea that entrepreneurial behavior is more strongly tied to perceived control (in this case, water security) than to access to markets. This is consistent with TPB, which highlights the importance of external resources and control over the environment. It also aligns with recent literature showing that in resource-constrained settings, foundational needs (such as water security) may be more important for entrepreneurship than market access alone. The negative relationship between entrepreneurial engagement (Ent) and water security (Watsec) in the model suggests that, among urban smallholder farmers the study areas, as water security increases, entrepreneurial engagement decreases. This inverse relationship is quite unexpected, as water security is typically assumed to enhance entrepreneurial activities, especially in resource-intensive sectors like agriculture. However, the small explained variation in entrepreneurial engagement may be indicative that there are other factors more pertinent in explaining entrepreneurial engagement among smallholder urban farmers in the study areas. Smallholder urban farmers face constraints distinct from rural farmers, such as limited land, high operational costs, and market access issues, which water security alone cannot resolve.

The inverse relationship might indicate that smallholder urban vegetable farmers in the study areas rely heavily on secure water resources for their entrepreneurial activities. As water becomes more secure, they might not feel the pressure to innovate or expand their businesses. In other words, a surplus in water security could reduce the necessity for risk-taking and entrepreneurship, as their basic operational needs are already met. The finding could imply that when water security is high, farmers become more risk-averse, focusing on sustaining current operations rather than seeking out new entrepreneurial opportunities. The assurance of water might lead to a conservative approach, with less inclination to innovate or diversify. The result may also highlight other barriers to entrepreneurial engagement that become more prominent when water security is assured. For instance, farmers might face other challenges such as market access, financial constraints, or a lack of entrepreneurial training, which still hinder engagement despite secure water resources.

Some studies have found that when basic resources like water are guaranteed, there can be a shift toward less entrepreneurial behaviour, particularly in subsistence or smallholder farming (Tantoh & McKay, 2023; Wale et al., 2021b). This may align with behavior often observed in rural settings where increased security in resources reduces the perceived need for innovation, as farmers focus more on maintaining rather than growing their businesses. In other studies, it has been found that while water security supports operational continuity, other factors such as weak market linkages, financial barriers, or inadequate policy support can still hinder

entrepreneurial activities even when resource security is assured (Chikozho et al., 2020; Durga et al., 2024). This may explain the negative association between *Watsec* and *Ent* in the model as secure water access is not enough to overcome other significant entrepreneurial barriers in the study areas (Durga et al., 2024; von loeper et al., 2016). While the inverse relationship between water access and entrepreneurship is statistically significant, it indicates association rather than causality.

6.8 Conclusions

The study investigated the determinants of entrepreneurial engagement among smallholder urban farmers in Sobantu and Mphophomeni Townships, with a specific focus on the role of water security and market access. The structural equation model revealed a significant inverse relationship between water security and entrepreneurial engagement, indicating that improved water access may lower the motivation for innovation and risk-taking among farmers. This suggests that when essential resources like water are readily available, farmers may be less inclined to explore new business ventures, focus on growth, or diversify their income streams. This further suggests that there are other factors more pertinent in explaining entrepreneurial engagement among smallholder urban farmers in the study areas. Smallholder urban farmers face constraints such as limited land, high operational costs, and market access issues, which water security alone cannot resolve for improved entrepreneurial engagements. Conversely, the non-significant effect of market access on entrepreneurship underscores the need to explore other factors that might be more critical in driving entrepreneurship in this context. The results point to an essential nuance in the Theory of Planned Behaviour (TPB), where resource availability, while facilitating operational aspects, might reduce perceived necessity for entrepreneurial action. This aligns with recent findings that resource stability can decrease urgency for business development among small-scale farmers, though this is context dependent.

This study recommends that the potential determinants of entrepreneurial engagement, such as access to financial services, access to land, technological adoption, and institutional support should investigated in urban settings. These factors could offer a more comprehensive understanding of the challenges and opportunities for smallholder urban farmers. Furthermore, conducting longitudinal studies would help track how changes in resource availability, such as water access and market conditions, influence entrepreneurial activities over time, providing insight into the sustainability of entrepreneurial efforts in urban farming. Finally, we recommend the use of a larger sample in future studies, which might be a significant limitation of the current research study.

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Chapter 7: General Conclusion and Recommendations

7.1 Introduction

Urban farming and agricultural entrepreneurship engagements have great potential to improve household income and household food security and nutrition for urban dwellers. As the demand for locally grown food in urban areas rises, urban farming and agricultural entrepreneurship are becoming increasingly popular to strengthen urban food systems. Market access is essential to the sustainability and expansion of urban farming businesses to reach a larger client base and maintain economic viability. However, water security is a crucial component that supports urban farming endeavors. In addition to boosting agricultural productivity, consistent access to safe water is crucial for encouraging creativity and adaptability in farming methods and agro-processing activities. Despite the inherent promise, smallholder urban farmers confront a multitude of challenges that hinder their ability to access markets and engage in agricultural entrepreneurial endeavors. This study, therefore, explored the factors influencing agricultural entrepreneurship and market participation respectively. The study also explored the the role of water security and market access on entrepreneurial engagement among smallholder urban vegetable farmers. and how they influence the growth of urban-based farming in a world that is increasingly becoming more urbanized. The study intended to determine the potential and problems associated with agricultural entrepreneurship engagements, and how it affects smallholder urban farmers' capacity to integrate their products into the market.

Descriptive statistics, double-hurdle model, logistic model, fractional response model, Household Water Insecurity Access Scale (HWIAS), Two-step generalized least-squares (GLS) model, Principal Component Analysis (PCA), Factor Analysis (FA), and Structural Equation Modelling (SEM) were utilized to achieve the specific objectives of the study. This chapter presents the conclusions of the study and provides policy recommendations based on the results. Suggestions for future research are also provided in this chapter.

7.2 Conclusions

According to the results of the Logistic model, it is evident that various factors influence market participation decisions among smallholder urban farmers. Credit use, access to market information, access to labour, and owning a smartphone were identified as key drivers affecting the decision to participate in the market. On the other hand, the results from the fractional response model indicated that the level of market participation among smallholder urban vegetable farmers was significantly influenced by age, as younger participants, especially those under 35, were more open to using the government grant for job-seeking and entrepreneurial activities, cooperative membership, free input, storage, and market training. From the obtained results, it is therefore evident that market participation among smallholder urban farmers can be enhanced by increasing market information sources through market-empowered extension services and improved access to market information including through targeted radio, television, and Facebook application. Owning a smartphone was found to be key to accessing market information and accessing online market platforms. These findings underscore the multifaced nature of the drivers of participation decision and the participation level in the market. The key messages that were derived from the objectives are (i) market participation was primarily influenced by access to market information, credit, and training, highlighting the importance of farmer support systems (ii) entrepreneurial engagement is significantly shaped by intrinsic factors such as attitude and spirit, alongside access to inputs and information (iii) Water security, while essential for production, may reduce entrepreneurial drive if perceived as a safety net. Market access alone did not drive entrepreneurship, suggesting that entrepreneurial ecosystems require more than just access to buyers. Overall, the study revealed that to foster resilient and entrepreneurial urban farming systems, policy must go beyond improving access to water and markets. Instead, targeted interventions are needed that build entrepreneurial capacity, enhance institutional support, and promote innovation.

Principal Component Analysis (PCA) was used to create the agricultural entrepreneurship index which was used as a dependent variable in determining factors influencing agricultural entrepreneurship using a two-step generalized least-squares (GLS) model. The Results from the model indicated that entrepreneurial spirit, entrepreneurial attitude, farming interest, gender, education, farming information, selling produce, and the distance to input suppliers were significant factors that influenced agricultural entrepreneurship among smallholder urban vegetable farmers. Based on the obtained results, it is evident that in urban settings, agricultural entrepreneurship can be enhanced through the improvement of farming information and empowerment through formal education for urban farmers to improve the entrepreneurial spirit,

entrepreneurial attitude, and farming interest among the farmers.

The results from the Structural Equation Model (SEM) revealed a significant inverse relationship between water security and entrepreneurial engagement, indicating that improved water access may lower the motivation for innovation and risk-taking among farmers. This suggests that when essential resources like water are readily available, farmers may be less inclined to explore new business ventures, focus on growth, or diversify their income streams. This is evident in the study areas as tap water is readily available since it is provided by the municipalities, however, access to markets is still a challenge for the farmers. On the contrary, the non-significant effect of market access on entrepreneurship underscores the need to explore other factors that might be more critical in driving agricultural entrepreneurship in urban settings. The results point to an essential nuance in the Theory of Planned Behaviour (TPB), where resource availability while facilitating operational aspects, might reduce the perceived necessity for entrepreneurial action. These findings challenge conventional assumptions and highlight the need to consider local barriers beyond resource availability, such as market conditions and institutional support but also psychological capital. Psychological capital serves as a critical internal resource that influences farmer behavior and promotes agricultural entrepreneurship. By enhancing goal orientation, self-belief, adaptability, and optimism, psychological capital enables farmers to navigate the complexities of modern agriculture, fostering innovation and resilience in the face of challenges. These insights underscore the importance of integrating psychological capital development into agricultural policies, extension services, and training programs to support entrepreneurial success in rural contexts.

This study contributes significantly to the Theory of Planned Behaviour (TPB) by illustrating how attitudes, perceived behavioural control, and access to enabling resources collectively shape entrepreneurial engagement among smallholder urban farmers. The findings confirm that intrinsic factors such as entrepreneurial spirit and attitude are crucial in determining market participation and enterprise development, aligning with TPB's assertion that intention precedes behaviour. However, the study also extends TPB by showing that resource sufficiency, such as secure access to water, may reduce the urgency or perceived necessity to innovate or take entrepreneurial risks challenging the traditional assumption that improved resources always stimulate entrepreneurial behaviour. Furthermore, the study's findings reinforce the Resource Based View (RBV) by emphasizing the importance of both tangible and intangible resources in enabling market access. The integrated interpretation of TPB and RBV within this urban

farming context provides a more nuanced understanding of how behavioral intentions interact with structural constraints and enablers in shaping entrepreneurial outcomes. The limitations of the study include cross-sectional design, potential bias in self-reported data, and limited geographic scope, which must be considered when generalizing results.

7.2 Recommendations and Policy Implications

This study recommends that urban policies and programs that strengthen market training activities and form farmer co-operatives to meet market requirements and improve market participation among smallholder urban farmers are developed by local municipalities. The study recommends more involvement of younger farmers to bolster innovation for market participation. Younger farmers can be able to access market information more efficiently using smartphones and can use mobile applications to tap into online markets thus reducing transaction costs. Furthermore, the study recommends urban policies and programs that strengthen urban farming activities and market information sources, and entrepreneurship training activities to improve agricultural entrepreneurship endeavors among smallholder urban farmers.

It is important that urban dwellers receive formal education and training from government and non-government organizations to enhance entrepreneurial skills. Access to up-to-date information about transformative programs and platforms that aim to empower and change farmers through local and private networks is essential for the KwaZulu-Natal Department of Agriculture and Rural Development (DARD) and other non-governmental organizations. Support institutions must be strengthened immediately because of the impact that institutional elements have on the agricultural production systems smallholder farmers. This might entail setting up strong extension services, offering technical support, and making credit and storage facilities more accessible. Tailored extension services, with a focus on women and youth, should be expanded to address existing disparities in access to knowledge and networks. Infrastructure investments should enable digital access to markets, particularly for underrepresented urban farmers. There must be Collaboration among agricultural departments, local government, and NGOs must be strengthened to address institutional support gaps. Furthermore, locating input suppliers close to the urban farmers' farming plots can improve entrepreneurial activities.

7.3 Suggestions for future research

It is suggested that conducting longitudinal studies would be beneficial in tracking how changes in resource availability, such as land, water access, and market conditions, influence

entrepreneurial activities over time. This can be helpful to provide insights into the sustainability of entrepreneurial engagements in urban farming. Gender-disaggregated analysis is recommended to better understand structural barriers and design equitable policies. Furthermore, Comparative research across multiple urban contexts in South Africa would enhance the generalizability and policy relevance of findings.

Appendices

Appendix 1: Ethical approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

13 January 2023

Phiwokuhle Nqubeko Ndlovu (213546920)
School of Agriculture, Earth & Environmental Sc
Pietermaritzburg Campus

Dear PN Ndlovu,

Protocol reference number: HSSREC/00005119/2022
Project title: Market Access & Entrepreneurship and the role of Water Security in Urban-based Farming
Revised title: Market access and entrepreneurship and the role of water security in urban-based farming
Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 21 November 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted FULL APPROVAL.

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

This approval is valid until 13 January 2024.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

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

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/ms

Humanities and Social Sciences Research Ethics Committee
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Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

Appendix 2: Data Collection Tool

Questionnaire

Section A: Farmer information

Name and Surname: ……..

1. Sex

0. Male	1. Female

2. Age of the Farmer

3. Level of education

1. None, can't read & write	2. None, can read & write	3. Primary school	4. Secondary school	5. Tertiary school	6. Vocational training	7. Other (specify)

4. Marital status

1. Never married	2. Married	3. Divorced	4. Widowed

5. Main source of income

1. Government grant	2. Old age pension	3. Remittances (gift)	4. Wages (employed)	5. Farm harvest	6. Non-farm business	7. Other (specify)

6. Total income received by household per month

R

7. Are you a member of an agricultural co-op?

0. No	1. Yes

8. Do you have access to credit?

0. No	1. Yes

9. Do you have access to an extension officer/agricultural advisor?

0. No	1. Yes

10. Do you receive government support for inputs?

0. No	1. Yes

11. How many people in the household?

12. Type of farming

1. Conventional farming	2. Organic farming

13. Are you satisfied with the following infrastructure in your farming area?

	Strongly disagree=1	Disagree=2	Neutral=3	Agree=4	Strongly agree=5
Road condition					
Market availability					
Electricity					
Water supply					
Extension services					

14. Farmer support services

Did you use any credit or loan facility in the past 12 months? Yes=1 No=0	
If previous question is Yes, what was the main source of credit/loan? Relative or friend=1 Money lender=2 Savings club (stokvel)=3 Input supplier=4 Financial institution=5 (Specify name of financial institution… .....) Output buyer =6 Other=7(Specify) .....)	
What was the purpose of the loan/credit? Family emergency=1 Agricultural purposes=2 Other (specify.....)=3	
Were you able to pay back the loan/credit in time? Yes=1 No=0	
Did you receive funding or any other sources of credit support from government in the past 12 months? Yes=1 No=0	
Did you have any contact with extension officer in the past 12 months? Yes=1 No=0	
If previous question is yes, how often did you contact extension officers? Sometimes=1 Always=2	
Are the extension officers from: 1=Government/parastatal? 2=non-governmental organisation (NGO)? 3=Private company?	
Did you receive any free inputs in the past 12 months? Yes=1 No=0	
If previous question is yes, what was the source? 1=Government 2=Non-governmental organisation (NGO) 3=Private company 4= University	
What is your main source of farming information 0=None 1=Radio/television 2=Extension officer 3=Cell phone/SMS 4=Internet 5=Newspaper 6=Other farmers 7=Other (specify)…….	
Do you understand the information disseminated by the main information source in the previous question? Not at all=0 Somewhat=1 Absolutely=2	

Section B: Markets

Objective: ***To identify and explore the determinants of market access in urban-based farming.***

1. Do you sell your agricultural produce?

0. No	1. Yes

2. If yes, where do you sell your agricultural produce?

1. Large retailer	2. Fresh produce markets	3. Street hawkers	4. Government institutions (Schools, hospital)	5. Community & neighbors	6. Middlemen (Van)	7. Farm gate	8. Other (specify)

3. Do you receive market information?

0. No	1. Yes

4. If yes, where do you receive the market information?

1. Extension officer	2. Media outlets	3. Other farmers	4. Neighbours	5. University	6. Internet	7. Other (specify)

5. Who owns the land where you are farming?

1. Farmer	2. Municipality	3. Neighbour	4. Tribal authority	5. Other (specify)

6. What is total land size? _____ (Ha)

7. Do you have access to farm labor?

0. No	1. Yes

8. What is the distance to the nearest input market? _____ (km)

9. What is the distance to nearest output market? _____ (km)

10. What is the distance to the nearest town? _____ (km)

11. How is the state of the road to the nearest market?

0. Poor	1. Good

12. Do you have a storage facility?

0. No	1. Yes

13. Do you own a smart phone?

0. No	1. Yes

14. What value addition do you practice?

1. Washing	2. Sorting	3. Grading	4. Processing	5. Packaging	6. None	7. Other (specify)

15. Do you have access to an extension officer?

0. No	1. Yes

16. Have you received any market access training?

0. No	1. Yes

17. How do you get your produce to the market?

1. Own Vehicle	2. Hired Vehicle	3. Bus/ taxi	4. Buyers collect	5. Other (specify)

18. Please indicate the extent to which you agree with following statements pertaining to your constraints to urban- farming operations

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Constraints	**Response**
Lack of access to inputs	
Large unaffordable increase in input prices	
Production below normal	
Declining market prices for outputs	
No markets	
Increasing food prices	
Land tenure not secure	
Not enough land	
Local and political conflict	
Lack of support services	
High pump and maintenance cost	
Water availability	
Other (Specify)	

19. Please indicate the crops you planted in the past season, the area you planted, the output you produced and the costs you incurred (Complete the table below).

Crop name	Area planted (m^2)	Quantity harvested (e.g., Bags,	Production sold at the market in various	Price per unit (R)	Total income (R)	Total costs of production (R) (e.g.,	Net income (profit)

		crates, bundles) / Kg	units (e.g., Bags, crates, bundles) / Kg			inputs, transport, labor)	(Total income – Total costs of production)

Section C: Entrepreneurship

Objective: ***To identify and explore the determinants of entrepreneurship in urban-based farming***

1. **Smallholder entrepreneurial spirit**

Please rate the extent to which you agree with the following statements

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Entrepreneurial spirit	**Response**
I often take risks.	
I often seize opportunities.	
I am good with problem solving.	
I am proactive (hands-on).	
I am independent.	
I am innovative.	
I am competitive.	
I can embrace change.	
I have good self-control.	
I have good vision.	

2. Farmer interest in agricultural entrepreneurship

Please rate the extent to which you agree with the following statements

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Farmer interest	Response
Do you believe this area is profitable?	
Do you have a desire to have own business?	
Are you motivated in running a business?	
Are you free to make own decisions?	
Do you believe you can manage own business?	
Do you have the time to manage your own business?	
Do you think farming can offer employment to others?	
Do you think trainings can increase Agric skills?	
Do you believe that farming has a good future?	

3. Farmer attitudes

Please rate the extent to which you agree with the following statements

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Farmer attitude	Response
The social grant is sufficient money to maintain the household	
The government is responsible for the wellbeing of urban households	
The government must create more job opportunities	
People are poor because they were not given equal opportunities as others	
I do not blame anyone for the poverty of my family	
I have power to affect the outcome of my farming	
I trust other farmers	
I have interest in running a farm as a business	
I have sufficient capital to farm	
I often fail to sell farm produce due to lack of market access and poor market prices	
Input costs of farming are far too high	
Labour costs are too high	
Poor quality of the agricultural extension service is a major bottleneck	
Am interested in farming perennial crops	

4. Entrepreneurial Characteristics

Please rate the extent to which you agree with the following statements

Strongly disagree=1Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Entrepreneurial characteristics	Response
I like being my own boss	
I produce mainly for the market	
I produce mainly for household consumption	
I view my farm as a means of earning profits	
I view my farm as a profit-making business	
I know what and when resources and materials are needed and where to get them	
I know where the most profitable market for each enterprise is	

I am passionate about my farm business	
I can adapt quickly to market changes and market opportunities	
I always look for better and profitable ways to run farm operations	
I am able to recognise market gaps and exploit market opportunities	
I deal with problems as they arise rather than spend time to anticipate them	
I manage my farming business as a long-term venture with a view to making it sustainable	
I try things that are very new and different from what I have done before	
I stick with my decisions even if others disagree strongly with me	
My production decisions are based on what is possible, not just what I need	
I work long and irregular hours to meet demands	
I am highly motivated and ambitious	
I understand how to motivate people	
I have the ability to inspire and energize others	
I always welcome change and view it as an opportunity	
I am very flexible and always willing to adapt	
I always take responsibility for solving problems that I face	
I always cooperate with others	
I possess persuasive communication and negotiation skills	
I have the ability to set goals and set new ones once attained	
Despite many difficult circumstances, I often tend to not give up	
I am very competitive in nature	
I am always willing to learn new things	
I am very hands-on	
I tend to take control in unstructured situations	
I welcome failures from which I am able to learn	
I seek information that will help with tasks I am working on	
I find ways to complete tasks faster	
I weigh my chances of succeeding or failing before I decide to do something	
I seek the advice of people who know more about the tasks I need to accomplish	
I prefer situations in which I can control the outcome as much as possible	
I am willing to co-operate with other farmers to buy inputs	
I prefer activities that I am familiar with and with which I am comfortable	
I take action without wasting any time to gather additional information	
If one problem is persistent, I try alternative approaches to address it	
I think of solutions that benefit everyone when solving a problem	
I am happy to do someone else's work in order to get the job done	
I am able to meet deadlines and do my work on time	

Section D: Water Security

Objective: ***To assess the role of water security (water availability and access) on entrepreneurial activity in urban-based farming.***

1. Is water available for your farming activities throughout the year?

0. No	1. Yes

2. Where do you access water for your farming activities?

1. Municipality (Tap)	2. River/dam	3. Rain harvest	4. Borehole	5. Other (specify)

3. Do you have the ability to pay for water-related services?

0. No	1. Yes

4. *Please rate the extent to which you agree with the following statements*

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 strongly agree=5

Question	Response
In general, the availability and security of water constraints my performance	
My right or claim to water is secure	
Water is sufficient for my cropping requirements	
In general, the water distribution network is not in a good condition	
I always get water to my plots	
I am satisfied with the water I receive in my plots	
I will always be able to raise money to pay for water or water-related services?	
In my opinion, government should pay for water-related services	
I have problems with too much water in my plot(s)	
The water I use for farming is good quality	
I often irrigate my crops	
The household has enough water for personal hygiene and consumption	
I have enough water for postharvest practises e.g., washing	

5. Do you think that having better access to water can improve your market access opportunities?

0. No	1. Yes

6. If Q5 is yes, how?

7. **Household Water Insecurity Access Scale (HWIAS)**

1 = rarely (once or twice in the past four weeks), 2 = Sometimes (three to ten times in the past four weeks), 3 = Often (more than ten times in the past four weeks).

Scenarios	Yes/no	Rarely	Sometimes	Often
1. In the past four weeks, Did you worry that your household would not have enough water? 0 = No (skip to Q2) 1 = Yes 1.a How often did this happen?				
2. In the past four weeks, were you or any household member not able to drink the kind of water you preferred because of a lack of resources?				
3. In the past four weeks, did you or any household member have to drink a limited/few water due to a lack of resources?				
4. In the past four weeks, did you or any household member have to drink some water that you really did not want to drink because of a lack of resources to obtain water?				
5. In the past four weeks, did you or any household member have to drink a smaller quantity of water than you felt you needed because there was not enough water?				
6. In the past four weeks, did you or any household member have to drink less water in a day?				
7. In the past four weeks, was there ever no water to drink of any kind in your household because of lack of resources to get water?				
8. In the past four weeks, did you or any household member go to sleep at night thirsty because there was not enough water?				
9. In the past four weeks, did you or any household member go a whole day and night without drinking water because there was not enough water?				

Section E: Food Security

1. **Food Insecurity Experience Scale (FIES)**

1 = Yes, 2 = No, 3 = Don't know, 4 = Refused

Recall period: 12 months

FIES questions	**Response**
1. WORRIED: During the past 12 months, was there a time when you were worried you would run out of food because of a lack of money or other resources?	
2. HEALTHY....., was there a time when you were unable to eat healthy and nutritious food because of lack of money or other resources?	
3. FEW FOOD: ....., was there a time when you ate only a few kinds of food because of a lack of money or other resources?	
4. SKIPPED: ....., was there a time when you had to skip a meal because of lack of money or other resources?	
5. ATE LESS ....., was there a time when you ate less than you thought you should because of lack of money or other resources?	
6. RUNOUT....., was there a time when your household ran out of food because of la ack of money or other resources?	
7. HUNGRY: ....., was there a time when you were hungry but did not eat because of lack of money or other resources?	
8. WHLDAY:....., was there a time when you went without eating for a whole day because of lack of money or other resources?	