An analysis of the value chain participation and profitability of smallholder irrigators in KwaZulu-Natal, South Africa

by

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DEDICATION

This thesis is dedicated to my family, thank you for all the support and patience.

DECLARATION

I, **Siyanda Ngcongo**, declare that:

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2. The thesis has not been submitted for any degree or examination at any other university,
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As the candidate's supervisor, I, Prof. M. Mudhara, agree to the submission of this thesis.

Signed: _____ Date: _____

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ABSTRACT

Smallholder irrigation farming is perceived as a transformative approach to poor rural households as it improves livelihoods and alleviates poverty. However, most smallholder irrigators are characterized by poor value chain participation because they lack market information and infrastructures such as bridges, good roads, and storage. Therefore, these constraints end up affecting their profitability. The study's objectives were: to identify actors involved in the value chain of smallholder irrigators, determinants of smallholder irrigators in the agricultural value chain, and level of participation, and to identify factors affecting the profitability of smallholder irrigators. Probability sampling involving a simple random sampling technique was employed to select 243 respondents from two irrigation schemes, namely, Tugela Ferry and Mooi River Irrigation Schemes (TFIS and MRIS) located in Msinga Local Municipality, KwaZulu-Natal Province, South Africa. The data were analysed using descriptive statistics, Multivariate probit model, Double-hurdle model, gross margin statistics, and multiple regression model. The study used STATA and SPSS computer software to process the data.

The study identified seven actors involved in the smallholder irrigators value chain: input suppliers, producers, collectors/hawkers, wholesalers, retailers, consumers, and value chain supporters. Value chain activities that farmers primarily performed were cleaning and sorting. The multivariate probit model results indicated that educational level, household size, transport reliability, market information, and farming experience significantly influence farmers' choice of market outlets for their produce. Further, econometric results showed that age, access to credit, extension service, access to roads, and livestock ownership significantly determine smallholder irrigators' value chain participation. Further, age, livestock ownership, land size, labour, credit access, and exchange of produce significantly influenced the extent of smallholder irrigators' value chain participation. The study's profitability results show a positive result for gross margin, indicating that smallholder irrigators generate sufficient income' on average' to sustain their livelihoods.

The multiple linear regression analysis results revealed that age, land size, access to credit, extension service, packing cost, and tractor hire had a direct relationship with the profitability of smallholder irrigators. The study recommends the improvement of the input supply system, creation of organisations or groups in order to facilitate marketing of produce surplus,

strengthening the linkage/interaction among producers value chain actors, training of farmers through workshops, seminars, strengthening extension services, demonstration farm plots is essential and expanding the accessibility of market infrastructure and supportive institutions.

Keywords: Value chain actors, value chain participation, profitability, smallholder farmers.

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NGP	New Growth Path
DAFF	Department of Agriculture, Forestry and Fisheries
NDP	National Development Plan
SHEP	Smallholder Horticulture Empowerment Project
NWA	National Water Act
RSA	Republic of South Africa
SIS	Smallholder Irrigation Schemes
IMT	Irrigation Management Transfer
IFAD	International Fund for Agricultural Development
EFA	Eksteenskuil Farmers' Association
FLO	Fairtrade Labelling Organization
UK	United Kingdom
SAD	South African Dried Fruits
BEE	Black Economic Empowerment
TGFIS	Tugela Ferry Irrigation Scheme
MRIS	Mooi River Irrigation Scheme
KZN	KwaZulu-Natal
NGOs	Non-Governmental Organisations
DH	Double-hurdle model
FAO	Food Organisation Association
SSA	Sub-Sharan Africa
GDP	Gross Domestic Product

JICA	Japan International Cooperation Agency
ANC	African National Congress

CHAPTER 1. INTRODUCTION

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1.1 Background information

The value chain is a series of activities that occur from the beginning of the product to the final consumers (Mmbengwa *et al*., 2014). Different actors undertake different functions that begin with an input process, several intermediate stages of product changes, value addition, and delivery to the market. Based on Kondowe (2016), strengthening agricultural value chains can be used to address problems and connect smallholder farmers to viable markets. Approximately 8.5 million people in South Africa directly or indirectly depend on agriculture as the source of income and employment (Moyo, 2016). Smallholder agriculture has been considered a crucial sector and an efficient engine of growth in improving rural livelihoods. DAFF (2012) stated that the New Growth Path (NGP) framework targets agricultural value chains as key sectors to support employment creation. This policy framework targeted job opportunities for 300 000 households in agricultural smallholder schemes with the addition of 145 000 jobs in agro-processing by 2020 (DAFF, 2012).

Ledger (2017) stated that the agricultural value chain in South Africa is well developed with significant downstream (agricultural inputs) and upstream (processing and retailing). In addition, Ledger (2017) argued that the entire value chain of the agricultural sector contributes around 15% to the South African economy. Therefore, this indicates that agriculture remains an important sector in South Africa for employment and food security. South African agriculture is considered a dualistic sector characterized by large-scale commercial and small-scale subsistence sectors (Pienaar, 2013). The reason for this can be traced back to the history of apartheid. There were many policies that were introduced from 1910 onwards by the apartheid government which supported the commercial farming sector and excluded small-scale farmers (Pieannar, 2013). The most notable of the policies and institutional measures include the 1912 Land Bank Act, 1913 Land Act, 1926 Agricultural Credit Act, and 1968 Marketing Act. The 1913 Land Act restricted black people from buying or occupying the land (Sihlobo and Qobo, 2021). White people became the largest landowners, where they would engage in commercial farming with the state betting of their success, providing them with subsidies, financial assistance, and creating a market for them. In 1926 the Agricultural Credit Act authorised the Land Bank to issue credits to white farmers, with their produce and personal security as collateral (Sihlobo and Qobo, 2021). Black South Africans were neglected and

marginalised to only be workers on the farms and in the mining industry. Policies that were implemented increased the gap between commercial and smallholder farmers, which still exists even today.

Moyo (2016) stated that commercial farmers own 87% of the agricultural land and smallholder farmers use only 13%. The transition from apartheid to a democratically elected government in 1994 entails a range of policy transformations to transform the agricultural sector into an open economy. Policy changes in the agricultural sector included the deregulation of the marketing system, labour legislation, land reform and, trade reform (Groenewald and Nieuwouldt, 2003). With these policy changes, many African farmers expected positive changes in the agricultural sector. However, small-scale irrigators continue to face numerous challenges such as, lack of technologies, lack of inputs, lack of storage facilities, limited smallholder irrigators in the value chain (Woldesenbet, 2013 and Mjonono, 2020). Similarly, Hirose (2014) and Kebede (2017) argued that the profitability of smallholder farmers was fraught with a different challenge, including low yields, poor quality of crops and, lack of access to credit.

Vroegindewey and Hodbod (2018) defined value chain participation as obtaining farm inputs and services and delivering farm products to buyers. This definition includes the sequence of activities required in the value chain. Agricultural commodities need to move from the farm where they are produced to the retail outlets bought. Therefore, road infrastructure and transport influence smallholder irrigators' value chain participation (Vroegindewey and Hodbod, 2018). In many cases, irrigation schemes are in areas where the infrastructure is not well developed, such as roads and the value chain actors are non-existent (Fanadzo and Ncube, 2018). There is a lack of market connectivity and inadequate storage, leading to local price slumps at harvest time (Fanadzo and Ncube, 2018). Smallholder irrigators rely on buyers or hawkers who buy produce from the field. Primary agricultural products prices have fallen, but retail prices for the same packaged, cut, and processed products have increased (Van Schalkwyk *et al*., 2012). This indicates that value-adding can help smallholder irrigators to increase their profitability. However, value-adding and agro-processing lack components amongst smallholder irrigators due to the lack of processing technology.

1.2 Problem statement

Since 1994, the government of South Africa has invested massively in supporting small-scale farmers from smallholder irrigation schemes to be involved in the formal value chain, but there are few success stories of small-scale farmers operating in a formal value chain (Jordaan and Grove, 2012). Therefore, the goal of improving the livelihood and increasing participation and profitability in the formal value chain of small-scale farmers through irrigated agriculture has not been achieved. Several factors limit smallholder farmers' productivity: geographical challenges such as insufficient water for irrigation or lack of access to limited production assets (land, labor, and farm machines) hindering farmers' capacity to generate a marketable surplus (Barrett *et al.*, 2010). Institutional constraints such as limited access to credit and insurance and insecure land rights further reduce the feasibility and attractiveness of agricultural value chain participation for smallholders (Barrett *et al.*, 2010).

Informal and formal value chains characterize agriculture in developing countries. Smallholder farmers are usually involved in the informal chain that delivers their produce to local middlemen and small local shops (Norton, 2014). Formal value chains deliver the same product, usually to the profitable markets driven by commercial farmers to commercial wholesalers and supermarkets and even export. However, the National Development Plan (NDP) vision 2030 has identified small-scale irrigators as the tool that contributes to job creation and improved food security (NDP, 2012). Currently, studies argue that more support is offered to small-scale farmers by the government. However, there has been less focus on linking small-scale irrigators to a profitable value chain (Mmbengwa *et al.*, 2014). There have been limited studies on smallholder farmers' value chain participation and profitability in South Africa. This study, therefore, filled that knowledge gap by underpinning drivers of value chain participation and profitability among smallholder irrigators.

1.3 Objectives of the study

The study's main objective was to analyse the value chain participation and profitability of smallholder irrigators in Msinga Local Municipality, KwaZulu-Natal.

- To identify actors involved in the value chain of smallholder irrigators.

- To identify the determinants of smallholder irrigators in the agricultural value chain and their level of participation.
- To identify factors affecting the profitability of smallholder irrigators.

1.4 Organization of the study

The thesis is organized into six chapters. Chapter one consists of the background of the thesis and the research problem, objectives. Chapter two presents the literature review, which provides an overview of smallholder irrigation, smallholder irrigation schemes in South Africa, the significance of smallholder irrigated agriculture, and value chains. The chapter also identifies constraints facing smallholder irrigators in South Africa from participating in a value chain and increasing their profitability, determining the factors influencing profitability, and outlining examples of smallholder farmers' experiences in the formal value chain. Chapter 3 presents the actors involved in the value chain of smallholder irrigators. In addition, results on factors influencing smallholder irrigator's participation and level of participation in the value chain are presented and discussed in Chapter 4. Chapter 5 presents the study results on the factors affecting the profitability of smallholder irrigators. Lastly, chapter six provides the summary, conclusions drawn, and recommendations to the study.

CHAPTER 2. LITERATURE RIVIEW

2.1 Introduction

Agriculture remains a critical sector for attaining economic growth in most economies in developing countries. However, to make a significant contribution to economic growth, the sector needs to be commercialized to enable smallholder farmers to participate in the value chain (Abdul-Rahaman and Abdulai, 2020). In the past two to three decades, agricultural value chains in developing countries have experienced dramatic structural transformation, driven by different factors such as increasing urbanization, population growth, increasing consumer income, and changing consumer dietary requirements (Henderson and Isaac, 2017 and Swinnen and Kuijpers, 2019). Value chain transformation is considered necessary in reducing rural poverty, improving food and nutrition quality.

In South Africa, agriculture provides about 70% of the employment in rural households and serves as the primary source of income (Hlatshwayo *et al*., 2021). Therefore, the agricultural sector has proven to be the backbone of improving rural livelihoods and food security. Smallholder farming in South Africa has become a significant issue within the agricultural sector after the first democratic election in 1994. The ANC-led government placed the development of smallholder farming as a priority on their agenda (Koatla, 2012). However, the sector faces multidimensional coordination factors, e.g., institutional difficulties, poor infrastructure, insufficient technology access, and inadequate resources (Sihlobo and Sibo, 2021).

This chapter presents the literature review, starting with the background of smallholder irrigation and smallholder irrigation schemes in South Africa. This chapter also discusses the significance of smallholder irrigated agriculture and explains the value chain concept and participation in the value chain. The following section provides the framework that links smallholder irrigators to the market (Smallholder Horticulture Empowerment Project (SHEP). In addition, the review highlights the constraints facing smallholder irrigators in South Africa participating in the value chain and increasing their profitability, followed by an example of smallholder farmers' experiences in the formal value chain.

2.2 Overview of smallholder irrigation in South Africa

South Africa is a water-scarce country and is the 30th driest country in the world in terms of available water per capita (Schreiner *et al.* 2010 and Botlhoko, 2017). Irrigated agriculture accounts for almost 30% of total crop production and is the single largest water user in the country (Fanadzo *et al.* 2010, Fanadzo, (2012), Baleta and Pegram, (2014). Fanadzo *et al.* (2010) reported that poverty alleviation and employment could be achieved through irrigated agriculture in rural areas. Similarly, Ntsonto (2005) reported that irrigated agriculture was the first step to promote development in disadvantaged rural areas. Botlhoko (2017) argued that access to reliable irrigation enables smallholder farmers to adopt new technologies, positively contributing to increased farm productivity and value chain participation.

South African agriculture is considered a dualistic sector, particularly the irrigation sector. However, the post-apartheid government is committed to changing this situation through the implementation of effective water policies such as the National Water Act 36 (1998) (NWA) (Mudhara, 2010 and Njoko (2014). The structure of dualistic consists of large scale well-resourced commercial farmers dominated by white people and small-scale, poorly developed farmers mainly black-owned (Njoko, 2014). Approximately 28 350 farmers operate under the commercial irrigation sector (Van Averbeke, 2008). Around 200 000 to 250 000 smallholder farmers practice subsistence irrigation activities mainly dominated by black females (Njoko, 2014).

Backeberg (2006) and Van Averbeke (2008) reported that 1.3 million hectares are under irrigation and approximately 0.1 million hectares belong to smallholder farmers. Only 12% of the land is suitable for practicing rain-fed agriculture in the country (Baleta and Pegram, 2014). A large part of agriculture in South Africa involves the practice of rain-fed crops. However, water requirements for irrigation are significant. In addition, smallholder irrigation in the South African context is referred to as irrigation farming practiced by black people (Botlhoko, 2017, Machethe *et al.*, (2004), Fanadzo (2012) and Fanadzo *et al.*, (2010).

Moyo (2016) stated that smallholder irrigation farmers are not homogenous. They are classified according to control over water supply, such as source and distribution infrastructure and scale operation (Van Averbeke *et al.*, 2011). Smallholder irrigators in South Africa have been categorized into four groups: farmers on irrigation schemes, independent irrigation

farmers; community gardeners; and home gardeners (Van Averbeke, 2008 and Botlhoko (2017). Njoko (2014) stated that the apartheid government supported white farmers, whereas black farmers were discriminated against. Therefore, South Africa's smallholder interpretation must involve the characteristics of the scale of small farms and must establish partially developed links with the more extensive economic system. Commercial farmers fully participate in export markets, whereas smallholder farmers are excluded.

2.3 Overview of smallholder irrigation schemes in South Africa

Smallholder irrigation schemes in South Africa are defined as multi-farmer irrigation projects that cover an area of more than five hectares in size and are formed by black people or agencies supporting their development in underdeveloped rural areas (Van Averbeke, 2008; Njoko, 2014; Denison and Manona, 2007). The government introduced SISs to increase agricultural productivity, enhance rural economic development, improve food security and the livelihoods of rural communities (Maepa *et al*., 2014). Van Averbeke *et al*. (2011) reported that in the year 2010, there were 302 smallholder irrigation schemes in South Africa covering an area of 47 667 hectares. Limpopo province has the highest number of smallholder irrigation schemes in the country, 183 SIS found in the province covering an area of 28 283 hectares, followed by Eastern Cape province, which has 75 SIS covering an area of 9 641ha and KwaZulu-Natal has 36 SIS covering an area of 6621ha (Mvelase, 2016, Denison and Manona, 2007).

Irrigation schemes in South Africa are divided into (1) Community/garden schemes: the power to manage these schemes is vested in the hands of the community members and their objective is to produce food for consumption and they are usually small in size; (2) Corporation financed schemes: government provides infrastructure down to farm gates, farmers pay a subsidized water fee and take most farming and management decisions ; (3) Bureaucratically managed small-scale schemes: farming is practiced on behalf of farmers by the government or agencies and large estate schemes: are state or private sector financed scheme: often managed by agents whose purpose is to maximize the use of resources through production of high return cash crops (e.g., coffee, tea, etc.) (Bembridge, 1997 and Perret, 2002).

Shah *et al*. (2002) reported that most smallholder irrigators in smallholder irrigation schemes in Africa produce low-value crops with poor assistance and have inadequate farm input and markets access. Their returns are not enough to maintain and revitalize irrigation schemes. Due to these poor performances of smallholder irrigation schemes, the South African government

has decided to establish ways to improve smallholder irrigation schemes. The two most recent eras in South Africa for irrigation development are Irrigation Management Transfer (IMT) and Revitalization era. IMT is based on decentralizing the responsibilities of managing, operating, and maintaining the irrigation schemes from the government to the farmers. The era aimed to improve the performance of irrigation schemes in South Africa by handing over the ownership to farmers (Van Averbeke *et a*l., 2011). The Revitalization era aimed to achieve the National Development Plan (NDP) objectives for socially uplifting, profitable participation to formal value chain on the current irrigation schemes and in the communities surrounding the schemes (Phakathi, 2016). The implementation of these Eras is because of the failure of SIS to achieve the primary goals of improving rural livelihood, productivity, and participation of smallholder irrigators in the value chain.

2.4 Significance of smallholder irrigated agriculture

Crop production is largely dependent on rainfall, in dry areas in Africa (Akuribaab *et al*., 2016). Poor performance of small-scale farmers has been noticed and considered to be a barrier to development (Akuribaab *et al*., 2016). Smallholder irrigation has long been seen as way to achieve food security by increasing crop yield production. Hence, there is an urgent need to improve the smallholder irrigation agricultural sector. Smallholder irrigation enables farmers to produce every season since farmers are no longer limited by the length of the rainy season and smallholder farmers can grow crops that require more reliable water supplies such as vegetables and fruits (Burney *et al*., 2013).

2.5 Value chain

Value chain approaches are widely promoted as a holistic intervention framework for inclusive smallholder development in evolving agri-food markets in Sub-Saharan Africa (Kilelu *et al*., 2017). Kondowe (2016) stated that smallholder farmers' problems can be addressed by strengthening the agricultural value chain. There are several processes or steps involved for a product to reach the consumer. Every step of the value chain needs to directly link to the next for the processes to form a viable chain (Digal, 2007). There are additional changes or improvements introduced to the product at each stage. Therefore, the value chain is defined as the sequence of value-adding activities from production to consumption through processing and commercialization (Digal, 2007 and Kaplinsky and Morris, 2001). The value chain also

seeks to understand how value is created and shared among the value chain actors. Hence, the value chain in agriculture can be understood as a set of different activities from the inputs stage to different stages of production to processing, marketing, and delivery to the consumer (Digal, 2007).

Jalang'o *et al*. (2016) defined a value chain as the quality improvement of a product at different transfer stages. Therefore, the main objective of the value chain is to deliver maximum value to the end-user for the least possible total cost. Jalang'o *et al*. (2016) reported that the value chain concept provides a valuable framework to understand and link all the steps in the production, transformation, and distribution of a commodity or a group of commodities. Cuddeford (2014) and Mitchel (2009) suggested that a value chain is a valuable approach to understanding the world of producing, purchasing, and selling products. The value chain must reflect four main actors: input, production, process, distribution, and marketing (Mitchel, 2009). Primary actors perform a selection of primary functions. They classically involve input supply, production, processing, storage, wholesale, retail, and consumption (Mitchel *et al*., 2009). Secondary perform secondary services roles that support primary functions, including transportations and service processing (Mitchel *et al*., 2009). As goods are transformed in a value chain, costs and value get added. Global markets have become demanding in variety and quality. In response, there is a need to develop a strong link of coordination between actors in a chain.

2.6 Participation in a value chain

Value chain participation is the ability of the farmer to be actively involved in a market effectively and efficiently (Poole, 2017). This research entails the transformation by the farmer from subsistence farming to a market engagement, whereby inputs for farming are increasingly purchased, value-adding, and outputs products sold off the farm to reliable markets (Poole, 2017). Participation of the farmer in a value chain is influenced by the ability of the farmer to meet the market expectations in terms of standard, quality, and ability to supply consistency (Baloyi, 2010 and Poole, 2017). Baloyi (2010) reported that participation in a value chain enables smallholder farmers to increase their income and reduce poverty. Similarly, Mmbando (2014) stated that farmers who participate in a value chain become profit-oriented rather than mainly being subsistence.

The participation of smallholder farmers in the value chain is constrained by several factors that are both internal to the farmers and external to the surrounding environment. Internal factors are obstacles that relate to the failure of farmers to meet markets expectations because of the absence of financial and physical assets such as credits and land (Poole, 2017). Lastly, the value chain for agricultural products involves many intermediaries between farmer and consumer, and each step increases risks and transaction costs which can reduce market efficiency (Kapungu, 2013).

2.7 Linking smallholder irrigators to market

The biggest food suppliers to formal markets are commercial farmers that produce high yields. Baloyi (2010) argued that for smallholder farmers to access markets they need to have access to market information. Linking smallholder irrigators to formal markets can boost their income and integrate them into the value chain as retail outlets attract a mass of consumer markets. In addition, for smallholder irrigators to be able to access formal markets need to comply with different standards such as safety regulations and packaging specifications (Kondowe, 2016). These standards are not easy for smallholder irrigators since they usually lack market information. Therefore, introducing Smallholder Horticulture Empowerment and Promotion Project (SHEP) to smallholder irrigators is significant to improve value chain participation. (Last edit).

The Smallholder Horticulture Empowerment Project (SHEP) was established in 2006 in Kenya (JICA, 2014 and Mgendi *et al*., 2019). The SHEP is a technical cooperation project cooperation with Japan. The horticulture empowerment was provided to the smallholder farmers by improving their capacity to manage market-oriented farming and their technical skills to produce per market requirements (Begashaw *et al*. 2019). Hence, SHEP was initiated to encourage smallholder farmers to conduct market assessments and grow profitable horticultural crops according to market demand (Shabangu, 2019). Both market stakeholders and farmers can share their own information and farmers understand not only price but also required quality, quantity, selling conditions and price fluctuations (JICA, 2014). In addition, SHEP also promotes gender equality with a clear purpose of strengthening farming couples' relationships as partners for farm management (JICA, 2018). Twenty-three African countries have participated in training courses of SHEP Approach, including South Africa. Lastly, since implementing the SHEP Approach, farmers have raised income from horticulture and improved farm productivity and livelihood (JICA, 2018).

2.7.1 Conceptual framework of Smallholder Horticulture Empowerment Promotion Project (SHEP) for smallholder irrigators

The Smallholder Horticulture Empowerment Project (SHEP) was established in 2006 in Kenya (JICA, 2014 and Mgendi *et al*., 2019). The SHEP is a technical cooperation project cooperation with Japan. The horticulture empowerment was provided to the smallholder farmers by improving their capacity to manage market-oriented horticulture farming and their technical skills to produce per market requirements (Begashaw *et al*., 2019). Hence, SHEP was initiated to encourage smallholder farmers to conduct a market survey and grow profitable horticultural crops according to market demand (Shabangu, 2019). Both market stakeholders and farmers can share their own information and farmers understand not only price but also required quality, quantity, selling conditions and price fluctuations (JICA, 2014). In addition, SHEP also promotes gender equality with a clear purpose of strengthening farming couples' relationships as partners for farm management (JICA, 2018). Twenty-three African countries have participated in training courses of SHEP Approach including South Africa. Since implementing the SHEP Approach, farmers have raised income from horticulture and improved farm productivity and livelihood (JICA, 2018).

This framework assesses the impact of the SHEP model on linking smallholder irrigators to the value chain. Figure 1 gives a schematic overview of this framework and shows the process leading to the Smallholder Horticulture Empowerment Promotion Project. This framework is explained starting from the top of the diagram. A large population of people in rural areas is engaged in agriculture. Despite this, horticulture crops tend to benefit exporters, distributors, and a portion of large-scale farms, whereas small-scale farmers lack the information to grow high-quality crops and settle for low prices presented by middlemen (Sigei, 2014). Figure 1 shows the hindering factors constraining smallholder irrigators from participating in the value chain.

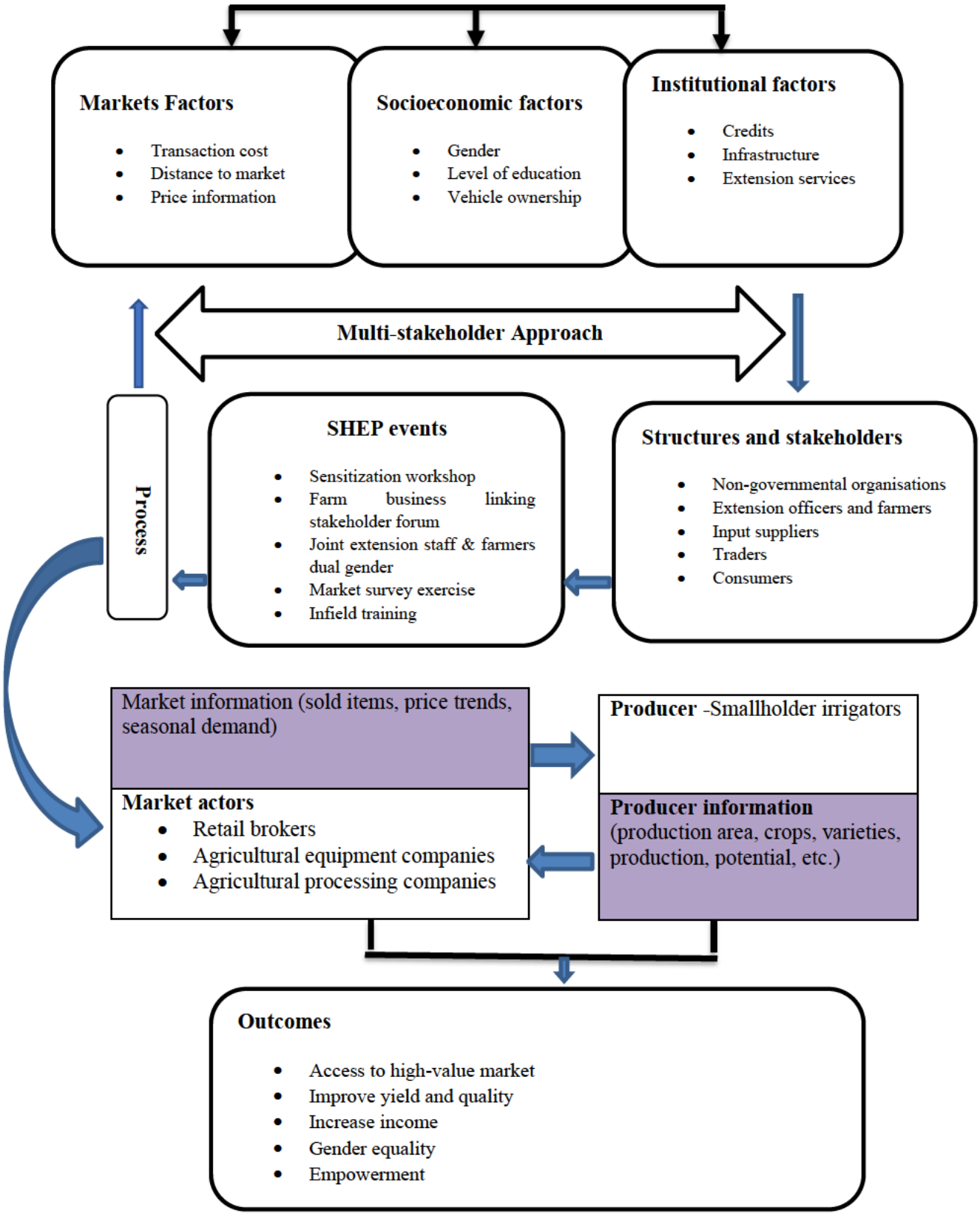

Figure 2.1: Conceptual framework for Linking smallholder irrigators to market (SHEP)

Source: Authors own construction

The framework introduces a multi-stakeholder approach to assist farmers in entering formal value chains. Multi-stakeholders work with farmers to practice SHEP events whereby farmers conduct market surveys themselves to understand market requirements. After completing all stages of SHEP, farmers reap positive outcomes.

2.8 Constraints facing smallholder irrigators in South Africa from participating in the value chain and increasing their profitability

Buthelezi (2013) reported that modern markets had replaced traditional markets and this has led to the negative outcome for smallholder producers because they have been excluded from a value chain, increasing the problem of rural poverty. The change of modern, dynamic markets is reshaping how food supply chains are governed, and it has been difficult for smallholder farmers to adapt to these transformations. Retail chains impose challenging standards for ill-prepared smallholder farmers to meet, leading to their exclusion from the value chain (Weatherspoon and Reardon, 2003).

Specifically, Maluka (2017) concluded that lack of expertise on grades and standards, contractual agreements, and poor organizational structures prevent smallholder farmers from participating in the value chain. Similarly, Baloyi (2010) reported that some smallholder farmers in South Africa have participated in the formal market. However, contracts were terminated because they could not meet the volume and quality of supply. Therefore, this indicates that formal market stringent requirements hinder the participation of smallholder farmers. Lastly, smallholder farmers often lack physical infrastructure, leading to high transaction costs (Bienabe and Vermeulen, 2011). Constraints limiting smallholder irrigators from participating in the value chain are discussed below in detail.

2.8.1 Access to finance

Access to credit is often regarded as one of the critical elements in improving agricultural productivity and value chain development (Baiyegunhi, 2014). Therefore, timely access and availability of credit, as indicated by Phakathi (2016) and Jordaan and Grove (2012), enables smallholder farmers to produce products that meet the standard requirements of the formal value chain. Manganhele (2010) further stated that access to credits could assist smallholder farmers in investing in agricultural technology and land improvements such as high-yielding seeds and chemical inputs that increase output to meet the market's requirements. Therefore, access to credit accelerates the adoption of new technology, increasing farm inputs and profits.

Accessing agricultural finance is a challenge for smallholder farmers in developing countries. The formal sector considers lending smallholder farmers a risky exercise (Ngcobo, 2018). Chisasa and Makina (2012) investigating trends in credit to smallholder farmers in RSA reported that credits are often given to commercial farmers while smallholder farmers may have very limited or no access to it because of institutional barriers. This conclusion is firmly supported by Ani *et a*l. (2009), who found that smallholder farmers often have difficulty accessing credit and financial institutions are typically biased against smallholders, particularly women farmers. Furthermore, the study that was conducted by Von Loeper *et al*. (2018) found that banks were not giving smallholder farmers credits because their commercial mandate focused on commercial farms that have collateral, a track record (credit history), and economies of scale. Similarly, Kondowe (2016) indicated that financial institutions require collateral from farmers to offer them credits. This gives smallholder farmers a competitive disadvantage on the value chain participation since smallholder farmers have limited access to land tenure security and collateral. Bjornlund *et al*. (2017) found that poor market information and integration into the value chain prevent smallholder farmers from accessing credit.

A study conducted by Manganhele (2010) found that most commercial banks are cautious about giving smallholder farmers credits in Mozambique. The same applies in South Africa; financial institutions only trust commercial farmers. Therefore, smallholders are forced to rely on informal lenders to fulfill their credit needs. However, these loans are not enough to satisfy all farm needs. They are given for a short period, resulting in smallholder farmers' failure to purchase farm equipment and other inputs. Lastly, International Finance Corporation (IFC) (2014) reported that commercial banks only lend about 1% of their funds to the agricultural sector in Africa. This indicates that the supply of credit to farmers is slow, and most smallholder farmers struggle to obtain credit from formal institutions. Therefore, this is the major contributor to the exclusion of smallholder farmers (Van der Heijden, 2010)

2.8.2 access to market

2.8.2.1 Quantity and quality

Production factors such as reliable water, land, and capital assets are crucial. Msomi (2017) argued that small-scale farmers do not have adequate modern technologies for crop harvesting

and postharvest handling facilities that are compulsory to attain high-quality products for formal markets. The majority of the small-scale farmers produce low quantity and poor-quality products (Baloyi, 2010). Salami *et al*. (2010) stated that smallholder farmers lack consistency, safety demand, and delivery schedules that the formal market requires.

Van Schalkwyk *et al*. (2007) and Magingxa and Kamara (2003) stated that it is rarely for smallholder farmers to understand what to produce, when and in what quantities or quality requirements, how the markets work, and why prices fluctuate. Therefore, lack of access to information results in poor participation of smallholder irrigators in the value chain. Due to the absence of intermediary actors ensuring linkages to the retail sectors and coordaining the supply chain to overcome the market's imperfections faced by smallholder farmers, smallholder farmers cannot comply with all the requirements of high-value agricultural markets (Swinnen *et al*., 2013). Most small farmers lack access to market demand regarding changing food regulations and quality standards (Jordaan and Grove, 2012).

A study conducted by Baloyi (2010) revealed that 76% of the small-scale farmers interviewed in Limpopo do not have access to market information, especially in market prices and seasonal trends for agricultural products. The farmers were also unaware of the quality requirements, prices at the local level and at the consumer level for the products, and better places to sell their produce (Baloyi, 2010). Similarly, Chikazunga (2013) found that formal markets among small-scale farmers in Limpopo province were not popular, resulting in low participation in a value chain. Hence, lack of market information results in the neglect of smallholder farmers' participation in a value chain (Van der Heijden, 2010 and Maitre d'Hotel *et al*., 2011).

The availability of and access to market information enables a farmer to make informed decisions. Smallholder farmers often rely on informal networks (friends and relatives) and government extension officers for market information. However, these sources may not be as reliable (Mdlalose, 2016). As opposed to this, Mmando (2014) found informal sources to be more effective at providing farmers with relevant information that would help them participate in value chains. Obtaining accurate market information is crucial for smallholder farmers to increase their profitability. Maltsoglou and Tanyeri-Abur (2005) concluded that incorrect price

information negatively affects smallholder farmers and that if the information is incorrect, the farmers may incur a loss.

Similarly, Makhura (2001) reported that most smallholder farmers' crops go to waste after harvesting or sold at low prices. Mdlalose (2016) stated that despite having an opportunity to participate, farmers have to take the price offered by the market due to the lack of information about prices. Finally, this suggests that more work is needed to improve smallholder farmers' access to markets.

2.8.3 Supply of inputs

2.8.3.1 Transaction cost

The challenges for the smallholder farmer in developing countries are multifaceted. Tackling the needs interventions such as institutional reforms that facilitate efficient rural service delivery, improvement of physical infrastructure, and development of markets (Alene *et al*., 2008). The agricultural sector is changing towards commercialization. Therefore, smallholder farmers require systems that are responsive to their needs: participation in the value chain and access to market information. However, smallholder farmers find it difficult to participate in the value chain in most South Africa because of several barriers. Transaction costs embody access barriers to value chain participation and profitability for most smallholder farmers (Holloway *et al*., 2000).

Several studies, such as Makhura (2001), Mthembu (2008), and Jordaan and Grove (2012), have mentioned high transaction costs as one of the key reasons for smallholder farmers' exclusion from a value chain. Most smallholder irrigators are far from service providers and major consumers in remote areas. Thus, a longer distance to the markets, poor infrastructure, and imperfect information add additional costs to entry activities (Mmando, 2014 and Osebeyo and Aye, 2014). Mdlalose (2016) and Senyolo (2018) stated that costs tend to be high during the rainy season since rural roads are inaccessible and in cases where buyers provide transport this additional cut the prices that buyers are prepared to pay to farmers. Thereby, high transaction costs deter smallholder irrigators and find it difficult to compete with profitable markets due to these high transaction costs.

2.8.4 Storage facilities

Several studies have reported that smallholder farmers do not have storage facilities to handle harvested and processed produce (Garikai, 2014; Nkolisa, 2017; Awan *et al*. 2012). Several studies have indicated that most smallholder farmers deliver fresh produce using non-refrigerated transport, resulting in spoilage and rejection by wholesalers and retailers. Lal Basediya *et al*. (2013) reported that farmers in developing countries experience almost 30-35% losses due to improper storage methods. Storage facilities such as cold rooms are crucial for farmers to keep their produce fresh and good marketable conditions. They also ensure quality maintenance for perishable agricultural produce after harvesting. Therefore, lack of storage results in farm products losing quality and failing to meet the market's standard. A study conducted by Mkhabela (2005) on technical efficiency in a vegetable in Tugela Ferry found that middlemen take advantage of smallholder farmers. They buy farmers' products at a low price and sell them to consumers in urban areas at a high price. The reason is that there are not sufficient storage facilities to store the product when the market price drops. Therefore, smallholder farmers are unable to take advantage of hoarding.

2.8.5 Input cost

Kondowe (2016) stated that the majority of the smallholder farmers in developing countries use retained seeds which results in low yields and poor-quality output, due to the poor germination of these seeds produce fruits or vegetables of poor quality which are rejected in the formal markets. For example, the study that was conducted in some East African countries revealed that smallholder farmers are struggling with the marketing of agricultural inputs, they were too expensive for this reason, farmers have greatly reduced the use of quality inputs such as fertilizers and pesticides (Salami *et al*., 2010). Tanzania's Poverty and Human Development 2007 report revealed that 87% of smallholder farmers were not using chemical fertilizers, 77% were not using improved seeds and 72% were not using pesticides (Salami *et al*., 2010). The reason for using poor quality inputs was the high cost of quality inputs. Therefore, farmers do not produce the quantity and quality that the formal market requires.

Kondowe (2016), most small-scale farmers are located in places where the soil quality is poor. To improve soil quality, a farmer needs fertilizers to boost production and these inputs are unaffordable. The study conducted by Louw and Jordaan (2016) on supply chain risks and

smallholder fresh produce farmers in the Gauteng province revealed that farmers were complaining about the cost of inputs, citing that they were too expensive. Therefore, they had to cut their spending on various inputs and reduce their levels of production to afford some inputs. That resulted in a decrease in yield and profits. Therefore, a decrease in production level results in excluding farmers' participation in a formal market that requires consistent quantity and quality. Ferris *et al*. (2014) argued that even though sometimes the government provides input, the problem is that delivery of fertilizers and seeds is notoriously slow, and distribution is often given to only a few favoured farmers.

2.8.6 Transportation and infrastructure

Availability of transport and infrastructure is critical to accessing both input and output markets. Poor infrastructure development in rural areas constrains smallholder farmers' access to markets. Jordaan and Grove (2012) stated that poor infrastructure conditions in rural areas contribute to smallholder farmers' higher transaction costs. Road infrastructure plays an imperative role in influencing smallholder value chain participation, primarily if they are located far from consumption centres (Van Schalkwyk *et al*., 2007 and Gabre-Madhin, 2001). By providing proper roads, farmers can transport their products more quickly to the markets and supply them securely and timely (Mdlalose, 2016 and Senyolo, 2018). However, poor road networks limit farmers' access to input and output markets for rural farmers (Kapungu, 2013). For example, Phakathi (2016) found that some smallholder farmers in Limpopo province are forced to sell their products to larger farmers because they have bargaining power and are able to access the market because they have access to transport.

Smallholder farmers find themselves at the disadvantage of participating in a value chain due to the lack of infrastructure in rural areas. Roads are blocked at certain times of the year (Jordaan and Grove, 2012). Similarly, Khapayi and Celliers (2016) stated that smallholder farmers in South Africa are situated in rural areas far from the public roads, and farmers are serviced by gravel roads that are not well maintained and blocked during the rainy seasons. Therefore, it undermines the ability of producers to buy their inputs and sell their crops on time, it results in high transportation costs and high transaction costs, both to buyers and sellers; and it leads to uncompetitive, monopolistic markets (IFAD, 2003 and Machete, 2004).

The majority of smallholder farmers do not own vehicles, and they have to hire transport to move their goods to the markets (Kondowe, 2016). A study conducted by Mbatha (2019) found

that most smallholder farmers in Msinga depend on public or hired vehicles to transport their produce to the market. This jeopardizes the value chain participation of smallholder farmers. These findings concur with those of Mdemu *et al*. (2017) reported that transport facilities are inadequate in sustaining agricultural projects in most rural areas. Machette (2004) and Amede (2015) also reported that most irrigation schemes are found in remote areas where infrastructure is underdeveloped, links to markets are limited and the value chain actors are non-existent. Therefore, schemes are not easily accessible and restrict producers' access to production inputs and constrain farmers in transporting their produce to the markets. Lastly, poor infrastructure conditions affect the quality of farmers' produce and cause products to be uneconomical and excluded from economic participation in value chains (Von Loeper *et al*., 2016 and Phakathi, 2016).

2.9 Factors determining profitability of smallholder irrigators

Different factors have been named as the factors that affect the profitability of smallholder farmers. These determinants can be negative or positive to smallholder irrigators. Age, distance to the market, yield, farm size education level of the farmer and experience of the farmer are some of the identified factors determining the profitability of smallholder farmers (Karane, 2016).

Karane (2016) found that an increase in age negatively affects the profitability of smallholder farmers. The increase in age leads the farmer to decrease in confidence and be innovative and lose physical abilities to do manual work. Therefore, energy to produce a sufficient quantity of marketable produce is affected and directly negatively affects farmers' profit. On the other hand, Bahta and Baker (2015) indicated that an increase in the age of households might positively influence farm profitability. This could be attributed to the fact that older farmers tend to be more experienced and can use their obtained experience and knowledge to use inputs efficiently. The longer the distance from the production area to the markets, the lesser the chances to participate in a value chain, hence less profit because of transport costs (Xaba and Masuku, 2013). Therefore, it negatively affects smallholder irrigators' profitability since most are located in remote areas.

Samboko (2011) indicated a positive relationship between education and profitability. Education helps farmers to make informed decisions. An educated farmer will comprehend and understand what is involved in the credit scheme and adopt new technologies (Samboko, 2011).

Therefore, this results in good agricultural practices and production management, hence improving yield and profits. Kebede *et al.* (2017) argued that smallholder farmers own small pieces of land, resulting in low profit. However, an increase in land size could positively affect profitability because when the size of the land increases, total production increases. Therefore, profitability is also expected to increase (Rugube *et al.*, 2019).

2.10 Smallholder farmers experiences in the formal value chain

There are cases of success that have been reported by different researchers whereby smallholder farmers from South Africa successfully participate in a formal value chain. Louw *et al.* (2008) stated that there are different markets options open to smallholder farmers in South Africa, including greengrocer shops, informal markets, and fresh produce markets.

2.10.1 Eksteenskul Raisin Producers

Eksteenskul Raisin Producers is in the Northern Cape Province of South Africa (Jordaan and Grove, 2013). This area is a rural colored settlement. Smallholder farmers produce vines for raisins. The area has 600 hectares of irrigable land cultivated by 76 households that farm an average of 3.6 hectares (Jordaan and Grove, 2013). In 2003 the Eksteenskuil Farmers' Association (EFA) obtained accreditation from the Fairtrade Labelling Organization (FLO) to export their choice grade raisins to Traidcraft, a Fairtrade affiliated buyer from the United Kingdom (UK) (Jordaan, 2012).

Members produce individually and farmers sell his/her produce independently to the depot of South African Dried Fruits (SAD) (Jordaan, 2012). SAD grades raisins to ensure that the product meets the market requirements. Farmers only get access to the incentives through the crops they export via-fair trade initiative (Jordaan, 2012). SAD is the only fair-trade accredited processor in the area and farmers only have a choice to sell their raisins to SAD if they are willing to participate in the fair-trade value chain (Jordaan and Grove, 2013).

2.10.2 Fruit and wine value chain: Thandi Fruit

Thandi became the first Agricultural project to benefit from South African government policy AgriBEE (Black Economic Empowerment (BEE). This brand enabled workers to own farmland and become beneficiaries (Oertle, 2017). Thandi project is an initiative that market

and promote fruit and wine products from smallholder farmers (Louw *et al.*, 2008). This project is a partnership between workers, growers, wine and fruit, fruit export companies, and the state (Jordaan, 2012). This is one of the most successful projects as it has managed to sustain itself for more than ten years in a highly competitive business environment regardless of an unfair trade regime. According to Louw *et al.* (2008) and Jordaan (2012), smallholder farmers need to practice collective activities to reduce the challenges of high transaction costs and improve their bargaining power to increase their competitiveness. In this case, workers from seven fruit growers were joined together as suppliers to the export company Capespan (Buthelezi, 2013). Louw *et al.* (2008) stated that farmworkers might become co-owners of a successful commercial agri-business. However, this needs political will, strong partnership, and capital.

2.11 Chapter summary

The study sought to understand value chain participation, assess profitability, and determinants among smallholder farmers in Msinga Local Municipality. The review has given a broad overview of the South African agricultural sector. This review concludes that South Africa still has huge inequalities in land ownership and dual agricultural value chain. Different policy interventions, precisely the Natives Land Acts, Agricultural Credit Act, and 1968 Marketing Act caused duality within the sector. Smallholder farmers in South Africa produced crops only on 13% of the agricultural land. Modern markets have replaced traditional markets, and only part of the production process occurs on the farm. Agriculture relies on industrial products such as fertilizers, pesticides, machinery, and tertiary services such as banking, insurance, and delivery. Hence, agriculture links with other sectors of the economy.

Several studies concur that smallholder farmers in South Africa are underperforming because of constraints. Common barriers reported by scholars include lack of storage, access to finance, transaction costs, lack of information, and poor infrastructure for distribution of produce. Hence, these constraints limit smallholder farmers' participation in the value chain. Therefore, if these constraints can be addressed profitability and livelihood of rural people can improve. However, several smallholder farmers reported that successful benefit and participate in a value chain. The cited South African case studies include Eksteenskul Raisin Producers (Eksteenskul Raisin Producers) and Fruit and wine value chain: Thandi Fruit. This chapter introduced the Smallholder Horticulture Empowerment and Promotion approach (SHEP) expected to promote market access and participation by smallholders and help farmers develop the technical and managerial capacity to practice market-oriented horticultural farming.

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CHAPTER 3. ACTORS INVLOVED IN THE VALUE CHAIN OF SMALLHOLDER IRRIGATORS

ABSTRACT

Marketing outlet choice is one of the most significant farm household decisions to sell their produce in different marketing outlets and has a massive impact on household income. Market outlet choices are based on household-specific factors, and several factors should be considered in making such a choice. Different socioeconomic and institutional factors can influence smallholder farmers' decision to choose market outlets. Smallholder farmers transact their produce through outlets that offer lower prices due to the lack of market information or challenges in accessing more remunerative markets. These various factors can also result in smallholder farmers choosing not to participate in the market. Understanding the producers 'choice is essential in developing strategies and programs to address barriers facing farmers' value chain participation or market access.

The chapter aimed to identify actors involved in the value chain of smallholder irrigators. Using primary data collected from 243 sampled households selected from two irrigation schemes in the Msinga Local Municipality, KwaZulu-Natal Province, 61.73% participated and 38.27% did not participate in the market. The study estimated a multivariate probit model to explain the factors that influence the market outlet factors. The econometric results indicated that education, household size, transport reliability, market information, and farming experience influenced market outlet choice. The study recommends that the government improve the input supply, strengthen the linkage/interaction among value chain actors, encourage adult education through extension service, improve market infrastructure, and strengthen supportive institutions.

Keywords: Value chain actors, market outlets and Multivariate Probit

3.1 Introduction

Agriculture plays a vital role in developing countries, where it is the backbone of the economic system (Taruvinga, 2011). In addition, agriculture provides food for the population and raw materials for the industrial sector (Amekawa, 2010). Among the majority of Africans living in rural areas of Africa, it is their primary source of income (Kilelu *et al*., 2017). The transmission of food from the farmer to the consumers happens through a series of value chain activities. Modern-day consumers are conscious of food safety issues and food quality, which have implications for the food value chain. The evolution of the food value chain is characterized by changes in agri-food systems linked to trends such as increased incomes, changing dietary patterns, and consumer preferences. The changes in the value chain offer both opportunities and threats to the involvement of smallholders in remunerative local and global markets (Kilelu *et al*., 2017). Globally, most agricultural production does not reach consumers directly from production but is marketed via various channels. Farmers participate along the value chain. The value chain represents the diverse actors involved in production and consumption activities.

Access to markets is an essential requirement for small-scale farmers' development. However, small-scale farmers in developing countries are limited to accessing formal value chains. South African government has invested a substantial amount in improving the performance of small-scale farmers, but performance remains poor (Shange, 2014). Lack of infrastructure, access to price information, transaction costs, and lack of credits constrain smallholder farmers. Therefore, these constraints mean that smallholder farmers generally face significant challenges in participating in the value chain (Aliber *et al*., 2010 and Davis, 2013). The chapter presents the methodology and results, and discussions of the study. Descriptive statistics with the help of tables and figures were applied to show the results. It begins by discussing the analytical framework followed by research methodology and findings on the farmers' socioeconomic characteristics, such as age, sex, family size, educational level, and farming experience. The chapter of the study also presents value chain actors and their roles. Smallholder value chain actors were those stakeholders involved in any field of activities directly or indirectly at any value chain stage. The chapter concludes by discussing commercial farmers.

3.2 Theoretical framework

A value chain analysis identifies different processes a produce goes through and distinguishes the actors involved in the chain. Input suppliers, producers, processors, traders and consumers are the actors involved in the value chain process. In this study, Trienekens (2011) framework for value chain analysis provides a structure for producing and trade and helps define actors involved in the chain. Trienekens value chain concept enables the indication of different linkages and actors involved in the chain of producers. Consumers are the end of the value chain and eat the final produce. In the middle may be different stakeholders performing small steps in the chain, i.e., transporting, selling and packaging.

3.3 Research methodology

3.3.1 Description of the study area

The data collection was conducted across two irrigation schemes: Tugela Ferry and Mooi River Irrigation Schemes (TFIS and MRIS) located in Msinga Local Municipality, KwaZulu-Natal Province, South Africa. The homesteads within the area are sparse from one another. The area experiences a low level of economic development and lacks infrastructure. Community, social, personal services sector and agriculture are the primary sources of employment in Msinga Local Municipality. Agriculture in Msinga is still primarily practiced for subsistence and agricultural practice in the area is limited by poor soil quality, adverse climatic conditions and poor technologies (Msinga Municipality, 2018).

Tugela Ferry Irrigation Scheme occupies 837 hectares in seven blocks, one of which is not used (Cousins, 2012). The irrigation scheme has been in operation since the 1800s (EnviroPro, 2019). Cousins (2012), argued that about 1,500 irrigators participate in the scheme. Sinyolo (2013), reported that 15% of all smallholder irrigators in KwaZulu-Natal province (KZN) are from Tugela Ferry Irrigation Scheme. Farmers in the scheme were initially allocated two plots each of 0.1 ha in size. After that, some farmers have managed to obtain more plots through leasing or borrowing from neighbours or relatives that are not using them (Sinyolo, 2013). The cost of leasing a plot ranges from R200 to R450, which is paid after harvesting. Farmers indicated that plots are not equal in size, as some farmers acquired additional plots over time through various means. The main access to land is through the traditional authorities who

allocate land to households (Njoko, 2014). The selling of land is not permissible under the current traditional land tenure system.

Mooi River Irrigation Scheme is one of several government smallholder irrigation schemes developed in former homeland areas of South Africa during the apartheid era, mostly for community food supply purposes (Muchara *et al*., 2014). Water is distributed from the main canal through in-field canals to the edges of the plots (Gomo, 2012). The scheme has 15 Blocks, of different sizes and serves about 850 irrigators (Dlangalala, 2018).

3.3.2 Data collection, sampling techniques and analysis

Data collection was conducted in 2020 using a structured questionnaire to interview household heads. Data included household head characteristics, plots owned/rent (in/out) by farmers, source of credit, storage, competition and level of participation in the markets, and challenges faced by the farmers when accessing markets. Secondary data was collected from journals, books, magazines, newsletters, websites, and government records to validate the survey results. The researcher trained the enumerators to be familiar with the questionnaire. The training involved reviewing all the research questions in the questionnaire. It also involved explaining the type of data required from each question. Questions were translated from English to the local language, IsiZulu. The questionnaire was pre-tested before the actual survey. Repeated questions and questions that were not clear were removed.

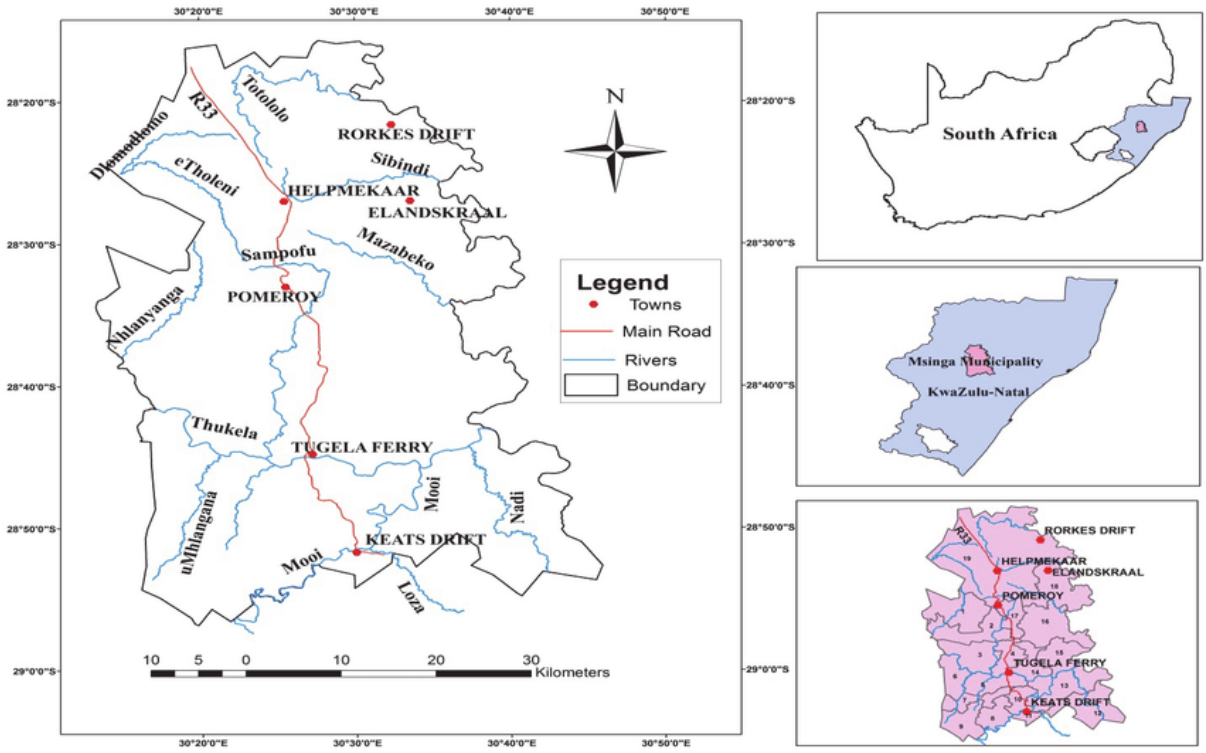

Figure 3.1: The Tugela Ferry and Mooi River Irrigation Schemes in the Msinga local municipality, South Africa.

Source: Adapted from Njoko and Mudhara (2017).

The uMzinyathi District Municipality comprises four local municipalities: Endumeni, Nquthu, uMsinga, and Umvoti. The target population was smallholder irrigators in the uMsinga Local Municipality. Mzibuko (2018) defined population as total units or complete cases or elements that include objects or individuals for obtaining observable information. Tugela Ferry and Mooi River Irrigation Schemes were chosen because of a substantial level of crop farming activity occurring. A sample of 243 farmers was selected to participate in the study. The sample was randomly selected from a population of 2 350 farmers from TFIS and MRIS in Msinga. The smallholder farmers list containing farmers was obtained from the local Department of Agriculture office in Tugela Ferry. In addition, 87 farmers were selected from MRIS and 156 were from TFIS. The sample size (10.34% of the population of farmers) that was selected was large enough to provide reliable data for the study.

Data were analysed using STATA and SPSS version 27 computer software. Descriptive analysis was employed to summarize data collected from smallholder irrigators to answer the objective. Descriptive statistics such as maximum, minimum, mean, frequencies, standard deviation, and percentages were applied to identify actors involved in the value chain of smallholder farmers.

3.4 Empirical models

Multinomial models are appropriate when the individuals can choose only one outcome among the mutually exclusive, collectively exhaustive alternatives. In this study, producers' choices about market outlets are not mutually exclusive. Smallholder irrigators are more likely to choose two or more types of outlets simultaneously in the study area. Therefore, the Multivariate Probit model was preferred because it simultaneously captures the influence of the set of explanatory variables on each of the different outlets' choices, while allowing the unobserved (error terms) to be freely correlated (Belderbos et al. 2004). The farmer's decision of whether or not to choose is considered under the general work of utility or profit maximization and is conditional to socioeconomic, institutional, production, and market-oriented factors (Addissu, 2016). The functional form of the Multivariate probit model is specified as follows.

$U^{i}_{n} = X^{i}_{n} + e^{i}_{n}$

Where U^{i}_{n} is the utility achieved from the outlet's selection

X^{i} are the different market outlet alternatives and

e^{i}_{n} is the error term representing the uncertainty involved in the producers outlets choice decisions.

Letting $\mathbf{X_1}$, **í**= 0,1,2,3…… alternatives, then the utility function of the producer is satisfied by 1 to n alternatives.

$U = (X_1, X_2, \ldots\ldots X_n)$, where X represents the alternatives chosen by a particular producer. The farmer selects a combination of various alternatives, X_1 to X_n based on the utility achieved and maximum profit obtained and a vector of farmer-specific institutional and socioeconomic factors determining market outlet choice.

The utility maximization model of the farmer is based on the expected value of the non-observable underlying utility function that ranks the farmer's preference according to the selected market outlets. The non-observable underlying utility function can be represented by:

E [Uín(Pn,Mn, Tn)

where E is the expectations operator

n indicate the market outlet,

í= indicate the farm producer.

Utility (Ui) is derived from the observable market outlet characteristics, where:

P indicate price offered,

M stands for market information and

T stands for the transport reliability.

The producer opts among,

E[Ui1], E[Ui2], E[Ui3], E[Ui4] and E[Ui5]

where E [Ui1] represents wholesalers,

E [Ui2] represents retailers,

E [Ui3] represent collectors,

E [Ui4] represents hawkers and collectors.

E[Ui5] represents local consumers

Table 3.1 presents 10 explanatory variables hypothesized to determine the market outlet choice of smallholder irrigators, i.e., age, gender, education, household size, access to credit, transport reliability, Trust in buyers, market information, extension services and farming experience. The explanatory variables captured in the model are discussed in Table 3.1.

Table 3.1: Description of variables for the determinants of market outlet choice

Variable	**Variable description**	**Units of measurement**	**Expected sign**
Dependent variable	Market outlet	1=Wholesalers 2=Retailers 3= Collectors 4= Hawker& Collectors 5= Local consumers	
Age	Age	Number of years	+
Gender	Sex of respondent	1 =YES, 0 =Otherwise	+/-
Educ	Educational level	Level of education of the household	+
Hshlds	Household size	Continuous(number)	+/-
Credit	Credit access	1 =YES, 0 =Otherwise	+
Tranrlb	Transport reliability	1=if Reliable,0=Otherwise	+
Trstbuyr	Trust in buyers	I =if Trust, 0=Otherwise	+
Mktinf	Market information	1 =YES, 0 =Otherwise	+
Extenserv	Extension services	1 =YES, 0 =Otherwise	+
Exper	Farming experience	Continuous (years)	+

3.5 Justification for inclusion of hypothesized variables

3.5.1 Age and farming experience: The variables are hypothesized to have a positive relation to the market outlet decision of farmers. Older and experienced farmers clearly understand the most profitable market outlets. Therefore, as the age and experience of the farmer increases, the likelihood of choosing the profitable market's outlets increases (Mwembe *et al*., 2021).

3.5.2 Gender: Gender is a dummy variable that takes 1 if the household head is male and 0 otherwise. The variable is hypothesized to have either a positive or negative relation to the market outlet decision of farmers. Bebe *et al*. (2012) stated that the majority of women are resource-constrained. Therefore, male household heads have more chances to choose profitable market outlets than female household heads.

3.5.3 Education: Education is expected to contribute to farmers' market outlet decisions positively. Education increases the basic knowledge of handling a commercial transaction and gives educated farmers an advantage in gaining more returns by venturing into more profitable market outlets (Astewel, 2010).

3.5.4 Household size: Household size is a continuous variable and refers to the total number of family members. The variable is hypothesized to have either a positive or negative relation to the market outlet decision of farmers. Family members mean more labour for production and the availability of labour is assumed to increase the marketable surplus. Therefore, it results in higher chances of integrating into more profitable market outlets. In contrast, a larger family size requires a larger amount for consumption, reducing the marketable surplus.

3.5.5 Access to credit: Access to credit is a dummy variable that takes 1 if the household head has access to credit and 0 otherwise. The variable is hypothesized to have a positive relation to the market outlet decision of farmers (Hailu, 2016). Credit improves farmers' capacity to cater for harvesting, packing, and transport costs needed to sell to other market outlets apart from local consumers and collectors. Credit enables farmers to attain better yields, thus selling to bigger markets for better returns (Hailu, 2016).

3.5.6 Transport reliability: Transport reliability is a dummy variable that takes 1 if the household head has reliable transport and 0 otherwise. The variable is hypothesized to have a positive relation to the market outlet decision of farmers. Reliable transport enables farmers to deliver produce to distant markets without any delays.

3.5.7 Trust in buyers: This was taken as a dummy variable. It takes a value of 1 if the outlet is trusted and 0 otherwise. Producers who trust buyers are likely to spend less time screening their transacting partners or following up on payments and delivering their produce to this outlet. (Hailu, 2016) Therefore, the variable is expected to contribute to the farmer's market outlet decision positively.

3.5.8 Market information: Market information is a dummy variable that takes value of 1 if the household head has access to market information and 0 otherwise. The variable is expected to contribute to farmers' market outlet decisions positively. Access to market information enables producers to make informed decisions about the prevailing market conditions. Therefore, access to reliable market information increases the chances of integrating into more profitable market outlets.

3.5.9 Extension service: This was taken as a dummy variable. It takes a value of 1 if an extension worker has visited the farmer for the past 12 months and a value of 0 otherwise. Extension officers transfer information regarding agricultural production, marketing, innovations, produce processing (value addition activities) to farmers (Musyoka *et al.*, 2020). Extension service is expected to contribute to the market outlet decision of farmers positively. Farmers who have frequent contact with extension officers have better access to information and could adopt better technology to improve marketable surplus (Ayelech, 2011).

3.6 Results and discussion

3.6.1 The demographic and socioeconomic characteristics of respondents

The demographic and socioeconomic characteristics of respondents considered included sex, educational level, marital status, age and family size. Table 3.1 shows the demographic characteristics of the smallholder irrigators in the study area.

Table 3.2: Demographic and socioeconomic characteristics of respondents

Variables		Percentage (n=243)
Sex	Male	23.05
	Female	76.95
Education level	No education	65.43
	Primary educ	18.93
	Secondary educ	15.23
	Tertiary educ	0.41
Marital status	Married	53.09
	Unmarried	46.91
Age (years)	Mean	54.56
Family size	Mean	4.21

Source: Own computation

3.6.2 Gender

The sample comprised mostly of female heads of households and only a few were male. Table 3.2 indicates that out of the total respondents in the study, 76.95% were females and 23.05 % were male. These results are consistent with Cousins (2012) who found that the majority of farmers in TFIS were females compared to men. Sinyolo (2013) argued that domination of females might be cultural because irrigation farming is taken to be a female activity in the area, while males focus on livestock rearing. Another possible reason leading to the dominance of women in the schemes may be that they are the ones supposed to put food on the table and being officially unemployed, they become more involved in agriculture (Satyavathi *et al*., 2010).

3.6.3 Marital status

A married couple can double their purchasing power as opposed to a single person (Matsoso, 2015). Some 53.09% were married while 46.91% were unmarried. The married couple is expected to work with their partners on the field, increasing labour availability (Badstue *et al*., 2020). Farming was the main economic activity in the schemes and the primary source of income for most of the participants in the study.

3.6.4 Age

Age is one of the most fundamental characteristics of agriculture. Usman (2016) argued that age reflects the productivity of the population as it has a bearing on the community's overall health. In general, older people are more susceptible to disease, lowering their productivity. Age can serve as a proxy for experience. The minimum age of the respondents was 24 years old and the oldest was 82 years old, with a mean of 54.5 years. This reveals that the majority of respondents in this study were aged. Hence, only a few young folks were participating in agriculture. During the discussion, farmers indicated that younger people were moving to urban areas to look for employment because the agricultural sector is paying less compared to other sectors such as mining. These findings are similar to Mine (2006) and Lwayo and Obi (2012) who reported that most of the younger people on the African continent move to urban areas; therefore, agriculture is practised by the older people.

Furthermore, Musah *et al*. (2014), Nwafor (2020), and Bahta and Bauer (2012) and stated that market participation declines with age. They indicated that younger farmers have more interest in participating in the market. The current results of the study found that market participants were older than non-market participants. The reason could be that older farmers have gained more market information and experience and have more contacts.

3.6.5 Household size

Household size influences the household’s monthly expenditure and can be a major factor in making decisions on labour allocation (Namulindwa, 2018). Muzah (2015) found that household size could be decreased due to migration to urban areas in search of better livelihoods. In the current study, the household consisted of a minimum of one household member and a maximum of 23 members. Having many households is seen as a benefit because

it minimizes direct labor costs. Etwire *et al*. (2013) reported that household size relates to agricultural practices. Similarly, Ssebuliba (2018) found that larger household sizes indicate the availability of labour. A farmer with a large household can delegate significant duties to other household members while the farmer is busy with agricultural activities. These findings apply more to women since they have many duties at home, such as cooking, washing and taking care of children (Bokelmann and Adamseged, 2016). However, the quantity of labour capable of performing farm labour depends on age. In contrast, Moloi (2008) found that a large family size can disadvantage because more people require food. Therefore, that may result in less money invested in production (purchase farm input), which negatively affects the area cultivated.

3.6.6 education

Education gives farmers vital knowledge. The educational level of the farmers in the study ranged from illiteracy to tertiary levels. Usman (2016) argued that the farmer's education level influences how he/she views new ways of farming and new technologies. Therefore, education can affect technology adoption decisions. These findings are similar to Simango (2015), who argued that lack of education hinders the ability to implement technologies and use technical information, negatively affecting farmers' participation in agricultural production. The survey results show that about 65.43% of the respondents were illiterate, 18.93% attended primary school and 15.23% attended secondary school, while only 0.41% attended tertiary education. These results indicate that only a few respondents had attended higher education. Therefore, due to the lower level of education, most rural residents are forced to focus on agriculture, which, comparatively, requires less skilled manpower. These findings are consistent with Dearlove (2007) and Mnkeni *et al*. (2010). This result also supports the one reported by Babalola *et al*. (2010) and Garikai (2014), where they concluded that most of the farmers in smallholder irrigation schemes in KwaZulu Natal are illiterate. Therefore, a high level of illiteracy hinders the new methods of practicing farm business and production and, as a result, smallholder farmers fail to compete in the modern market system where they have to compete with their well-organized counterparts, the commercial farmers (Garikai, 2014). Lastly, education and skills strengthen the working efficiency resulting in more income and food security (Namulindwa, 2018).

3.6.7 land

Access to land is necessary for people to take up farming as a livelihood option. Masikhwa (2018) argued that land ownership influences agricultural productivity because farmers who do not own land may not be motivated to invest in and make fixed improvements on the land. During data collection, it was discovered that access to irrigated land is not easy, especially for young people and young women in particular. Most farmers indicated that they inherited the land and others hired unused plots from others. Some farmers must pay rent upfront before farming and others pay after harvest. The smallest size of the land utilized was 0.1 hectares and the largest size was two hectares. The results show that 93.83% of the farmers in the irrigation schemes owned land, whereas 6.17% did not own land. However, this study's lack of land ownership did not mean the irrigators had no access to land. Findings revealed that 9.47% of the farmers rent plots in the irrigation schemes and 7.82% indicated renting out their plots. The majority of farmers that rented out their land were non-market participants. They stated that renting out their land assists them in getting finances to purchase farming inputs.

3.7 Agricultural assets

Table 3.3 shows that 48.52% of the respondents have cattle which they often use to provide traction power. None of the respondents in the study had tractors and all respondents owned a hoe and spade. Some 72.21% of farmers owned a wheelbarrow used for transporting inputs and produce. Some 8.13% of the respondents owned donkeys used for land preparation. In addition, 87.6% of the respondents owned watering cans used for manual irrigation and 98.3% of farmers had a machete used for harvesting, e.g., maize. Lastly, farmers indicated that owning livestock gives them an advantage of providing manure, an organic fertilizer, which helps to reduce fertilizer costs. The crops grown by farmers include potatoes, tomatoes, beans, cabbage, garlic, maize, onion, spinach, butternut, beetroot, chillies, sweet potato, green pepper and taro roots. These are planted both in winter and summer. According to Msinga Local Municipality (2014) maize is the main important crop produced by farmers in summer.

Table 3.3: Agricultural asset ownership

Type of agricultural asset	Percentage of respondents
Hoes	100
Cattle	48.52
Donkey	8.13
Wheelbarrow	72.21
Watering can	87.6
Machete	98.3
Spade	100

3.8 Smallholder irrigators' value chain participation

Finance is one of the most critical aspects of farming, particularly for input procurement. Farmers can use their own savings to finance agricultural activities or have to borrow money. Among the sampled producers in the study, only 27.96% had access to credit, while 72.04% had no credit access. Credit assists deprived farmers in purchasing inputs and adopting new technology.

This section analyses the smallholder farmer's value chain actors in MRIS and TFIS. It also highlights the responsibilities of the actors in the chain. Farmers were asked about activities between the point of production and consumers. The farmers identified different stakeholders in the chain. All the actors involved in the chain benefit from each other's activities if there are strong linkages. However, strong links depend on power relations between the participants. Power relations depend on trust, negotiation skills and sharing information (Bokelmann and Adamseged, 2016). The major value chain actors that were identified in the study are input suppliers, producers, collectors, wholesalers, retailers, consumers and value chain supports.

3.8.1 Input supply

The study areas had actors involved directly and indirectly in input supply. Input supply was categorized into two parts, value chain actors and supporters. Farm implement suppliers were considered input suppliers in the value chain actor and governmental or non-governmental organizations were considered the value chain supporters responsible for the supply of agricultural inputs such as seeds and fertilizers. Some 58.73% of the sampled farmers indicated

they purchased Tugela Ferry from retail outlets. These outlets sell agricultural inputs such as pesticides, fertilizers, and farm implements. In addition, 40.44% of respondents said that they buy farm inputs from Greytown and only 0.83% of respondents mentioned that they purchase their inputs from Pietermaritzburg. The input suppliers have significant roles in the value chain. However, none of these input suppliers are located in the community where irrigation schemes are located. Hence farmers travel long distances to buy inputs where the input suppliers are located.

TFIS farmers indicated that sometimes local retail suppliers run out of inputs stock. Therefore, they are forced to use Greytown as the second option for purchasing inputs. About 57.3% of sampled irrigators in the Tugela Ferry Scheme reported that they rely on this area if there are challenges with the local outlet. Similarly, 53.7% of sampled producers in MRIS reported that they purchase input in Tugela Ferry when the nearest supplier is out of stock. For fertilizers, 37.5% of the farmers prefer to use organic fertilizers or use a mixture of inorganic fertilizers when local suppliers are out of stock or farmers are short of cash. Farmers also depend on extension officers and other fellow farmers for services such as applying inputs. Buthelezi (2013) found that input suppliers in TFIS advise farmers about the most suitable varieties, how to produce high yields, climatic conditions, and advising farmers on what and how to spray against pests and disease.

There is an insufficient supply of certified seeds for certain crops such as potatoes and maize to the extent that 19.93% of farmers depend on informal seed sources. Some farmers' main source of potato seed is small seed tubers saved from the previous harvest. Farmers also mentioned the high cost of seed and lack of supply at the expected time and quality problems which lead to poor germination. About 56.38% of respondents reported that retailers do not provide them with the input quantities they need. Forty-four percent (43.62%) indicated that they always get the input quantities they need from retailers. Some 16.87% of the farmers mentioned that agricultural inputs are too expensive, and 19.75% stated that they do not always afford input every planting season. Instead, they end up using locally produced organic fertilizers. In addition, 19.34% indicated that retailers sometimes run out of stock during the planting season. This results in delays in planting. Lastly, only 0.83% indicated that they do not trust the local inputs retailers in terms of quality and, as a result, purchase their inputs in other places, e.g., Pietermaritzburg. Therefore, these findings are in line with the literature

review, which found that most smallholder farmers in developing countries use retained seeds, resulting in low yields and poor-quality output (Kondowe, 2016).

3.8.2 Producers

Producers are the main actors in the chain who produce a variety of crops. Producers perform most of the value chain function in the study from land preparation to postharvest handling. Some of the activities that farmers perform include ploughing, planting, fertilization, weeding, pest controlling and postharvest handling. Farmers sell their produce at the farm gate and village after harvesting due to the lack of proper storage and perishability of produce. Some 94.24% of farmers reported that they do not have storage and only, 5.76% of farmers indicated having storage. However, these are not cooled storage facilities. Farm produce can be spoilt in high temperatures due to the lack of cooling facilities.

Farmers with cooled refrigerators facilities do not have to sell their produce immediately after harvest when the price tends to be lower as they can store their produce and wait for better prices (Murugani and Chitja, 2018). Another reason that forces farmers to sell their produce immediately after harvest is to fulfill family demands such as school fees and settling debts. Due to the lack of proper storage and poor facilities to market, farmers incur high postharvest losses. Farmers lose between 20kg and 250kg after the harvest of their tomato produce from a total average harvest of 840kg. Nkolisa (2017) found that postharvest losses can be 600 kg at Msinga. Lehlohla (2005) reported that the average maximum temperature at Umsinga can reach as high as 30-35 degrees. Hence, the detected postharvest losses can be attributed to inadequate storage/unfavourable conditions, notably higher ambient temperatures, leading to a faster rate of produce spoilage.

Table 3.4 shows that 18.93% of the respondents experience 1-50 kg losses of their produce. About 25.93% of them lose between 551-100kg of their produce. In addition, 11.11% lose 101-200kg of their produce, and 44.03% suffer losses of 201-250 of their produce.

3.8.3 Collectors/hawkers

Collectors are value chain actors who purchase produce from farmers. Bakkie traders/hawkers play a fundamental role in the chain, collecting produce from the farmers and reselling it to retailers and at different destinations. The results revealed that 11% of farmers have direct

contact with bakkie traders. Farmers contact the traders directly once the produce is ready for the market. Bakkie traders buy farmers' produce in larger quantities. Some produce, such as potatoes and cabbages, are sold in different grade sizes. Larger-sized produce is more expensive than smaller ones.

Table 3.4: Postharvest losses experienced by farmers

Postharvest losses (Kilograms)	**Percentage (%)**
1-50	18.93
51-100	25.93
101-200	11.11
201-250	44.03
Total	100

Additionally, 27% of the producers arrange their own transport or use public transport to sell their produce at the informal market. They generate better profits than the farmers who only sell directly to the bakkie traders. They indicated that the reason for better profits at the farm gate is because buyers are willing to buy produce according to the set price, unlike bakkie traders.

Skjoldevald (2012) revealed that most smallholder farmers rely on middlemen who offer to buy their produce. Despite this, most middlemen purchase produce from farmers at a lower price, arguing that the quality of the produce is poor, and they incur additional expenses, such as transport. Similar, bakkie traders in the study were the main link between farmers and consumers. Smallholder irrigators indicated that bakkie traders are the reliable market for their produce. Since most of the smallholder irrigators utilize only small plots of land, middlemen have to visit several blocks in the irrigation schemes in order to fill their vehicles. In addition, 2% of farmers who had direct contact with bakkie traders indicated that the traders sometimes organise harvesting assistance and deduct the labour costs from the price.

A bakkie trader may grade produce on the spot and leave the farmer with all rejects. In addition, some farmers stores rejected produce for the following season of planting. Rejected small potatoes and taro roots were used to produce new crops the following season. Moreover, about 28% of the market participants sell their produce to bakkie traders. In contrast, 60.67%

of the market participants sell their produce to bakkie traders and the farm gate. Farmers that sell their produce to bakkie traders only indicated that selling to bakkies minimizes the hassles of trying to source transport when the produce is ready for the market. These findings are consistent with Sato (2019), who found that most of the smallholder farmers in irrigation schemes sold their crops to bakkie traders since bakkie traders were the most convenient markets for the majority of the farmers who did not own vehicles.

3.8.4 Wholesalers

Wholesalers buy large quantities of produced mainly from farmers at a low price and later sell to consumers at a higher price because of value-adding to the product and due to storage costs. Farmers transport produce to wholesalers. Only 6.67% of the market participants supply their harvested produce to wholesalers (Pietermaritzburg Fresh Produce Market, Freshly Pick'd and Clairwood Fresh Produce Market-Durban). Wholesalers demand that farmers adhere to the quality criteria since consumers expect high-quality produce. According to 3.2% of farmers who supply wholesalers, payments are delayed. Therefore, they end up waiting long periods for their money to be deposited in their bank accounts. Hence, late payments increase transaction costs as farmers accrue high interest on their loans.

3.8.5 Retailers

Retailers' involvement in the chain of smallholder irrigators includes purchasing farmers' produce. Bakkie traders operate in both the formal and informal markets. Hence, some retailers buy from bakkie traders and wholesalers. Farmers organize their own transport to deliver their produce to retailers. Furthermore, retailers practice different value-adding activities such as grading, cutting, and packaging. They are the last link between the farmers and the consumers in the value chain. Farmers stated that most consumers who buy from retailers are urban residents. Currently, 4.67% of the smallholder irrigators in the study supply their produce to retailers (Shoprite, Checkout, and SPAR). Only one farmer reported that she had secured a contract to supply a retailer with tomatoes (Shoprite). However, the chain store she is contracted to does not buy all her tomatoes even then. These results demonstrate that farmers need to have other reliable markets due to perishability since retailers only buy part of the produce. Similarly, Louw et al. (2008) argued that sometimes retailers decide not to accept

farmers' produce in cases of oversupply and take a small percentage. The retailer's small-scale irrigators procurement mainly involves cabbage, tomato, and potatoes.

3.8.6 Consumers

Almost all respondents to the study confirmed that they eat part of their produce. Some of the produce from the farm is sold directly to community members. About 23.33% of farmers noted that community members are their major clients. Previously, farmers mentioned that Bakkie traders prefer to buy large and middle-sized produce (good quality), especially potatoes and taro roots. Therefore, a large amount of small-sized produce is rejected and left on the farm. However, some community consumers that buy directly from the farm do not pay much attention to the quality as their major concern is price. As a result, a large quantity of small-sized produce is sold to local consumers and stored to produce new crops the following season.

3.8.7 Value chain supporters

Value chain actors provide essential services to the significant value chain supporters. These services include market information, credit service, and extension services. The Department of Agriculture is responsible for advisory services to farmers, such as husbandry practices and market information. The Department of Agriculture also sources and provides free inputs to producers. However, these inputs are not provided every season. About 92.4% of farmers reported that sometimes they receive free fertilizers from the Department of Agriculture. About 27.16% of the farmers had access to credit. Financial institutions such as banks provide credit services to the main actors in the value chain. These actors play an instrumental role in providing supportive services and an enabling environment for the main actors. However, smallholder irrigators were limited access to financial credit because of their lack of financial security. Similarly, Skjoldevald (2012) indicated that lack of sufficient market information, lack of credit services or high-interest rates, and poor market integration are the major constraints that discourage the main actors in a value chain of smallholder farmers.

Figure 3 illustrates the value chain in the study area. It illustrates how they produce information and money through and how between the different segments of the chain.

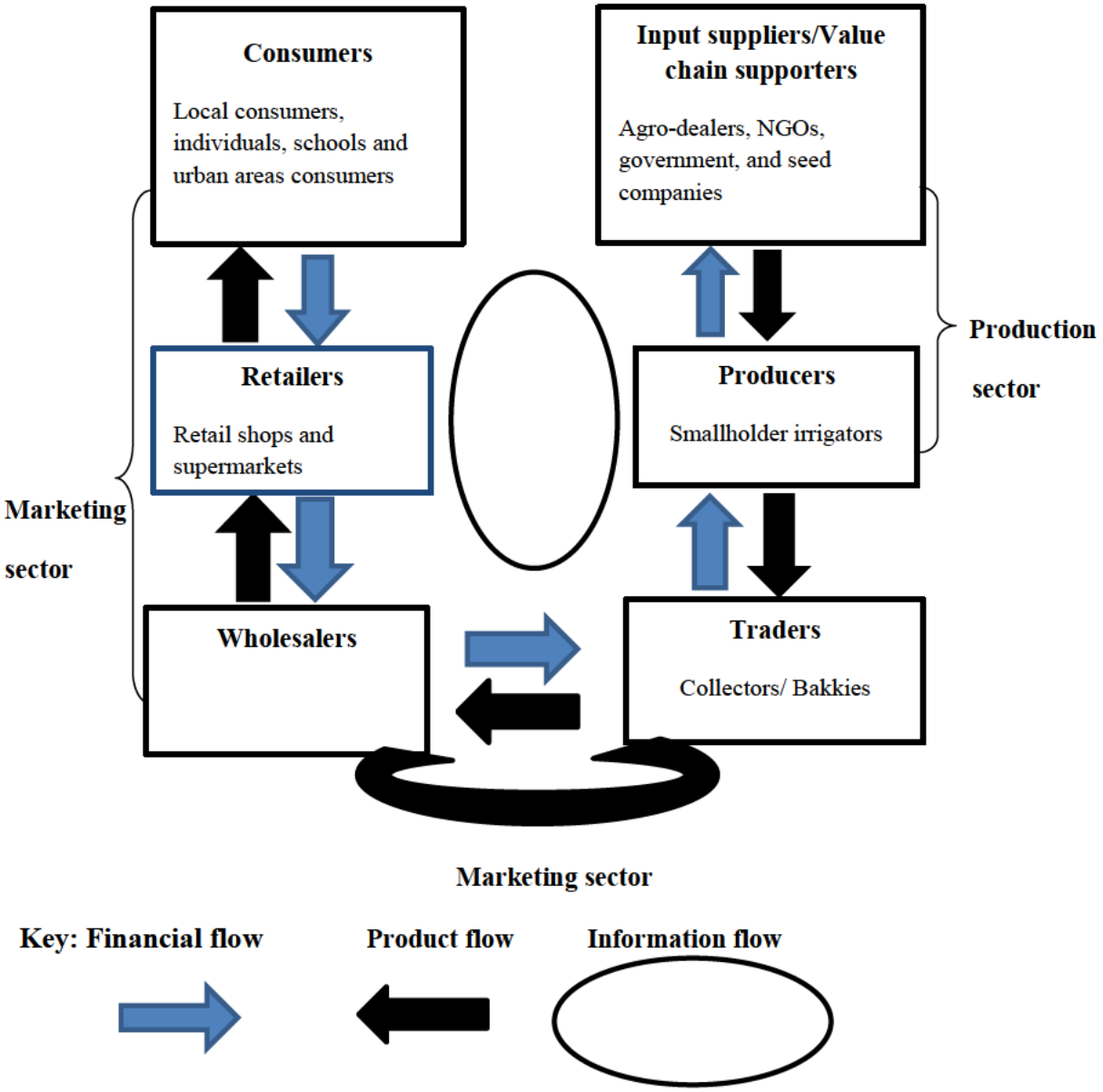

Figure 3.2: Producers value chain actors

Source: Authors own construction

3.9 Competition from commercial farmers

Smallholder farmers face competition from thousands of other farmers because they are selling similar produce simultaneously. Commercial farmers cultivate about 30% of the land in Msinga. Smallholder irrigators (TGIS and MRIS) identified commercial farmers as competitors. Respondents reported that commercial farmers have more agricultural knowledge, modern technologies, and experience. Commercial farmers produce better quality products compared to smallholder farmers. They deliver their produce in good condition since they have proper storage, transport, and harvesting machines that minimize produce damage. Therefore,

it results in unfair competition for smallholder farmers since their produce is sometimes rejected in the formal markets due to damages caused by poor handling. Furthermore, smallholder irrigators also compete against each other. An overwhelming majority of smallholder irrigators 58.6% of respondents, indicated that their competitors are the farmers from other blocks in the schemes. Whereas 15% of the farmers from TFIS reported that their competitors are farmers from MRIS.

According to 10% of farmers in MRIS, their competitors are from TFIS. Some 14.34% of the respondents in the study indicated that their market competitors are commercial farmers. These results indicate that small-scale farmers are excluded from the formal value chain since few participants compete with commercial farmers on the formal market. Hence, these results are in line with Selowa *et al*. (2015), who reported that the ability of smallholder farmers to contribute to economic growth continues to be limited since the majority of smallholder farmers in South Africa sell their produce locally, with only a small portion being exported or sold to the formal market. Some 29.42% of the smallholder irrigators stated that they conducted market research before. Lastly, 3.33% of the smallholder irrigators in the study indicated that they do not have competitors. Most of them were farmers that have direct contact with bakkie traders.

3.10 Econometric results

The stimulation maximum likelihood estimation result indicates that the probability that producers choose wholesalers, retailers, collectors, collectors & hawkers, and consumers market outlets were 6.67, 4.67, 28.00, 60.67, and 23.33 respectively (Table 3.5). This shows that the likelihood of choosing a retailer outlet is relatively low (4.67%) as compared to the probability of choosing wholesalers (6.67%), collectors (28%), collectors and consumers (60.67), and consumers (23.33%). As depicted in the table out of 10 explanatory variables included in the multivariate probit model three variables significantly influenced wholesaler's outlet, three variables significantly affected retailer outlet, two variables significantly affected collectors, two variables significantly affected hawker and collectors, and one variable significantly affected consumer market outlet choice at different probability levels.

Table 3.5: Multivariate probit estimations for determinants of producer's outlet choice

Variables	Wholesalers	Retailers	Collectors	Hawker& Collectors	Consumers
	Coeff (Rse)	Coeff(Rse)	Coeff (Rse)	Coeff(Rse	Coeff (Rse)
Age	-0.001(0.002)	-0.003(0.509)	0.005(0.04)	0.004(0.005)	0.004(0.004)
Sexresp	-0.008(0.469)	-0.041(0.039)	-0.012(0.086)	-0.011(0.094)	-0.011(0.094)
Educ	0.091(0.367) **	0.083(0.031) ***	0.069(0-067)	-.009(0.074)	-0.009(0.074)
Hshlds	0.006(0.064)	0.010(0.005) **	-0.002(0.011)	-0.019(0.012)	-0.019(0.012)
Credit	-0.081(0.542)	-0.070(0.045)	0.128(0.099)	0.171(0.109)	0.171(0.011)
Tranrlb	0.129(0.062) **	0.092(0.050) *	-0.098(0.011)	-0192(0.120)	-0.192(0.120
Trstbuyr	0.196(0.042)	0.003(0.035)	0.100(0.076)	-0.099(0.083)	-0.099(0.083)
Mktinf	0.079(0.043) *	0.018(0.037)	-0.134(0.079) *	0.007(0.087)	-.0.006 (0.087)
Extenserv	0.046(0.046)	0.033(0.039)	0.032(0.084)	0.068(0.092)	0.068(0.092)
Exper	0.002(0.002)	-0.055(0.141)	- 0.006(0.002) **	0.006(0.003)	-0.007(0.003) *
_cons	-0.249(0.167)	-0.055(0.141)	-0.005(0.308)	0.671(0.355)	0.386(0.290)
Observations (market participants)					150
Log Likelihood					-98.298
Waldχ_2 (48)					200.61
Prob>χ_2					0.0000***

Note: ***, **, * represent significance level at 1%,5% and 10%, respectively.

Coeff coefficient, Rse Standard errors in parentheses

Source: Survey data (2020)

3.10.1 Educational level (Educ): results revealed that the educational level of market participants was positively and significantly related to the likelihood of choosing a wholesaler

or retailer market outlet at 5% and 1% significance levels, respectively. This implies that the more educated a market participant is the more likely they are to sell produce through wholesalers and retailers. Nyaupane and Gillespie (2010) reported that more educated farmers make informed decisions with regard to the choice of marketing outlets to sell their produce based on the marketing margin and marketing cost.

3.10.2 Household size (Hshlds): Household size had a positive and significant influence on retail outlet choice. The positive sign indicates that farmers who have larger household sizes are more likely to sell their produce to retail outlets. Etwire *et al*. (2013) reported that household size relates to agricultural practices. Similarly, Ssebuliba (2018) found that larger household sizes indicate the availability of labour. Hence, it enables farmers to produce a marketable surplus that retail outlets require.

3.10.3 Transport reliability (Tranrlb): The probability of choosing a wholesaler and retailer outlet is positively and significantly influenced by transport reliability at 5% and 10% levels, respectively. This implies that market participants with reliable/own vehicles supply their produce to wholesalers and retailer outlets. In this respect, Hailu (2016) found that the supply of produce to wholesalers and retailers requires reliable transport to urban markets to meet wholesalers and retailers.

3.10.4 Market information (Mktinf): Market information has a positive and significant influence on the likelihood of choosing a retailer outlet at 10% level. Access to current price information improves farmer selling price because market information enables the farmer to analyse price difference in their locality that increases the probability of picking retailers and consumers, which give relatively better price to farmers. This result is in line with Bazabih *et al*. (2015), who reported that market information has positive and significant effect on retailer channel choice decision of potato producers. Moreover, the market information is negatively associated with the collector's outlet at 10% significance level. This implies that farmers are less likely to sell their produce to collectors 'outlet as they have access to market information. The rationale behind this may be due to the preference of other outlets that give a relatively better price.

3.10.5 Farming experience (Exper): Farming experience has a positive relationship with the likelihood of choosing a hawker& collectors outlet at a 10% level of significance. This implies that more experienced farmers are more likely to be hawkers and deliver their produce to the

collectors than the less experienced farmers. As farmers gain more experience in farming and marketing, they are more likely to adjust their marketing strategies, trying alternative marketing channels to improve sales volume or prices (Riziki et al., 2015). Moreover, the results show that the farming experience has a negative and significant effect on the likelihood of choosing collectors' market outlets at 5% significance level. This implies that experienced farmers are less likely to sell their produce through collectors and local consumers outlets. The negative relation may be due to preferences of other outlets that give relatively better prices. Tarekegn *et al*. (2017) reported that collectors purchase produce from farmers at a lower price. Therefore, farmers prefer to not only rely on one market outlet.

3.11 Conclusion and recommendations

The study employed data collected from 243 smallholder irrigators in Tugela Ferry irrigation scheme and Mooi River irrigation scheme. The study identified actors involved in the value chain of smallholder irrigators. Input suppliers, smallholder producers, collectors, hawkers, wholesalers, retailers, consumers and value chain supporters were identified as value chain actors in the study. The overall smallholder farmers value chains were constrained by several factors that hindered the development of their agricultural value chain. At the farm level, the production constraints were high prices of fertilizers, lack of storage, shortage of input supply, lack of improved seeds and inadequate credit service. At the marketing level poor market information, price setting problem, price fluctuations and perishability of produce were the problem.

The literature review indicated that agriculture in RSA is dualistic. The findings of this study agreed with this statement since only a few smallholder irrigators were found to be included in a formal value chain. The study concluded that the value chain of smallholder irrigators was ineffective. The multivariate probit model was applied in determining the factors affecting market outlet choice by farmers. The empirical results indicate that educational level and transport reliability positively influenced producers' choice of wholesalers and retail market outlets. Household size positively influenced producers' choice of retailer's outlet. Market information positively influenced producers' choice of wholesaler's outlet and negatively influenced collectors. Lastly, the farming experience had a positive and significant impact on hawker and collector markets outlets.

The study recommended that the input supply system be improved to receive high-quality inputs at the right time and quantity. Improving the system will also protect farmers from purchasing poor quality inputs at a high cost. The role of research institutes and extension officers is important in identifying high-yielding and disease-resistant varieties to increase production and productivity.

As part of strengthening linkage/interaction among value chain actors, it is necessary to change attitudes by developing ground rules that govern the relationship between producers and traders. In particular, positive attitudes toward partnership, interaction, networking, and learning need to be developed among the main actors in the value chain. So, the chain actors should integrate to improve production, reduce post-harvest losses, and strengthen sustainable market linkage in the study areas. In addition, organizing (voluntarily) traders and producers and establishing trustful and strong trade agreements between the two institutions is crucial to minimize unfair prices created by brokers.

South African government must revise their agricultural marketing policies and implement policies that will favour the conditions under which smallholder farmers operate. Smallholder farmers need to be protected from exploitative middlemen who take advantage of their cash needs. The government has to set and implement laws that indicate the minimum commodity buying price for produce to protect farmers from exploitation.

Empirical results show that educational level positively affected participation in high-value markets. Therefore, more efforts should be invested in ensuring that smallholder farmers are equipped with farming knowledge to improve their understanding of marketing mechanisms.

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CHAPTER 4: DETERMINANTS OF SMALLHOLDER IRRIGATORS IN THE AGRICULTURAL VALUE CHAIN AND THEIR LEVEL OF PARTCIPATION

ABSTRACT

Smallholder farmers' value chain participation in South Africa is low, even though valuable benefits are associated with value chain participation. Participation is expected to impact household income positively and thus enhance livelihoods. The study was undertaken to evaluate determinants of smallholder irrigators in the agricultural value chain and their level of participation in Tugela Ferry and Mooi River Irrigation Schemes located in Msinga Local Municipality KwaZulu-Natal Province. A total of 243 smallholder irrigators were randomly selected from schemes.

The data collected were analysed using both descriptive and Double-hurdle model (DH), age, access to credit, extension service, access to road, and livestock ownership had a significant role in value chain participation. Age, livestock ownership, land size, land size, labour, credit access, exchange of produce, and training in value-adding significantly affected the intensity of value chain participation. The study recommends that the policymakers and government of South Africa develop policies that will enhance smallholder farmers' participation in value chains to improve their livelihoods and household incomes.

4.1 Introduction

Kaplinsky and Morris (2000) define value chain as "the full range of activities required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use." Inputs provision, production, trading, processing, distribution and final consumption are the activities involved from production to consumption process in a value chain (Lemercier, 2019). Smallholder farmers are gaining much attention worldwide in the development policy debate because of their role in reducing poverty, food security and women empowerment (Bokelmann and Adamseged, 2016). However, smallholder farmers are at a disadvantage because they have little capital to invest, use traditional techniques, use family labour and lack connection with the significant market players, which results in exclusion from the value chain. Lemercier (2019) indicated that financial support is

vital for smallholder farmers in value chains. Financial support allows producers to buy quality farm inputs and machinery and meet the farm's running costs, which helps farmers improve productivity and meet agricultural value chains requirements. In order to participate in the modern value chain, farmers must adhere to the entry requirements and prerequisites suppliers impose, such as different specifications and minimum quantities (Csaky, 2014).

Smallholder farmers' ability to capture value determines their participation along the value chain (Mathagu, 2016). Value chain participation for smallholder farmers is largely attributed to value-adding, which includes using certified seeds, fertilizers, irrigation systems, and new technologies (Mjonono,2020). Value is added in different stages by different actors along the chain. The quantities the modern value chain buyers require from the single producer are generally much larger than smallholders can produce. In South Africa, smallholder farmers have a limited scope of participating in the value chain. The participation of smallholder farmers in the value chain is of significant importance for their inclusion in agricultural development in the third world countries (Sharma, 2016). Mmengwa *et al*. (2018) reported that smallholder farmers worldwide participate in the agro-food markets through local collector traders. Mapiye *et al*. (2007) indicated that most smallholder farmers are stuck in the primary agricultural products with little or no effort to add value. Therefore, marginalization results in farmers' difficulties processing their produce and participation in an agro-processing value chain. This study will contribute to understanding impediments affecting smallholder farmers in participation in the value chain. The development of agricultural activities is a significant avenue for improving the livelihoods of smallholder farmers and poor rural people.

The chapter includes the research methodology followed by descriptive demographic, institutional and market characteristics related to value chain participation. The chapter continues to outline empirical results of the double hurdle model for the econometric analysis of smallholder farmers' value chain participation, providing an in-depth explanation of significant variables.

4.2 Research methods

4.2.1 Study area

The data collection was conducted across two irrigation schemes: Tugela Ferry and Mooi River Irrigation Schemes located in Msinga Local Municipality, KwaZulu-Natal Province, South

Africa. Using random sampling, a sample of 243 farmers was selected in the two irrigation schemes. The study area was explained further in Chapter 3.

4.2.2 Data collection procedure

The data collection procedure for this chapter was similar to the one explained in Chapter 3, section 3.4.2.

4.3 Analytical framework

The study was built on the random utility theory, in which smallholder farmers decide to participate in the value chain or consume all farm output. Whether or not to participate was considered under the general utility or profit maximization framework. Therefore, smallholder irrigators will choose the alternative that brings the most significant utility (Sinyolo *et al*., 2017). The value chain participation decision consists of two stages: (i) the decision to participate in the market and (ii) the determination of the quantity to sell. Therefore, if farmers decide to sell in the market, they must decide the quantity sold. Socioeconomic, demographic, and institutional factors were hypothesized to influence these decisions (including age, education, household size, etc.). Value chain participation is associated with a continuous non-negative random variable, while not participating yields a variable with a zero value.

The Double-hurdle model was used for econometric analysis to determine the factors influencing smallholder irrigators' participation in the value chain and the level of participation (quantity to sell) (Cragg, 1971). The Double-hurdle model (DH) includes two estimation equations. The first hurdle is determining whether the farmer participates or does not participate in the value chain, and the second hurdle is determining the extent of value chain participation. Jones (1989) indicated that the logic behind the double hurdle is that an individual must pass two different hurdles before they are detected with a positive level of participation. The model was also used to the model two-step decision process, following market studies (Sinyolo *et al*., 2017; Sigei *et al*., 2014; Ndoro *et al*., 2014; Kyaw *et al*., 2018 and Khoza *et al*., 2019).

According to this study, smallholder irrigators' participation in the value chain refers to whether they add value to their agricultural produce and sell it to the market or otherwise. The second hurdle was market participation, measured by the quantity of agricultural produce sold. The double-hurdle model gives a framework to analyse, separately, the influence of some variables

on value chain participation decisions and the level of participation (Mekonnen and Alamirew, 2017). Hence, this approach uses the Probit model in the first stage of the analysis and then the truncated model in the second stage.

$P(Mp=1|X) = \Phi w_i y)$: the first stage indicating value chain participation

Where: P is the probability of participation, Mp is the binary variable of value chain participation, equal to 1 if the farmer chose to participate in value addition and equal to 0 if not, Φ is the standard normal cumulative distribution function, w is a vector of factors affecting value chain participation of smallholder farmers, y is the set of coefficients to be estimated.

$Z^*=x\beta+\varepsilon_i$: second stage representing the level of participation

Where: Z* represented the quantity of produced output, value-added and sold in kilograms (kg); x is the vector variable of factors affecting the decision to participate and extent of participation; ε_i is the error term; β's are parameters to be estimated.

Table 4.1 presents 15 explanatory variables that were hypothesized to determine the probability and level of value chain participation of smallholder irrigators. The variables are age, education, household size, gender, credit, labour, market information, extension service, produce spoilage, road, livestock, location, land size, exchange of produce and value-addition training. The explanatory variables captured in the model are discussed in detail below.

4.4.1 Education: The education of the household head was measured using formal schooling, showing the number of years spent in school. Moono (2015) found that education enables households to understand and interpret formal market requirements increasing participation in the value chain. This finding is consistent with Mmbando (2014), who indicated that educated households could negotiate and have more information than illiterate households. Further, Sigei (2014) found that the level of education for the household head positively influences value chain participation and the level of market participation. Thus, it is hypothesized that education positively influences value chain participation and the level of value chain participation among smallholder irrigators.

Table 4.1: Definition of variables hypothesized to influence the probability and level of value chain participation of smallholder irrigators

Variables	**Variable name**	**Expected sign**
Dependent variable • Determinants of value chain participation • Level of value chain participation		
Independent variable		
Age	Age of the household	+/-
Education	level of education of the household	+
Household size	Household size in persons	+/-
Gender	Gender of the household	+/-
Credit	Access to credit	+
Labour	Hire labour	+
Market information	Access to market information	+
Extension service	Access to extension service	+
Produce spoilage	Experience produce spoilage	-
Access to quality road	Access to road	+
Livestock	Livestock ownership	+
Distance to market	Location of the household head	-
Land size	Farm size of the household	+
Exchange of produce	Exchange produce for another commodity	-
Training in value adding	Access to value adding training	+

4.4 Justification for inclusion of hypothesized variables

4.4.2 Age: The age of the household was captured as a continuous variable. Age can serve as a proxy variable for the experience. Usman (2016) Argued that older household heads are wise in resource use. Therefore, it is expected to positively influence value chain participation and the level of value chain participation. Martey *et al*. (2012) indicated that age positively influences value chain participation among farmers. He found that aged farmers understand and practice different value chain stages. In contrast, Sigei *et al*. (2014) argued that aged farmers are less open to new ideas or change and risk-averse than younger farmers. Therefore, decreasing the chances of value chain participation. Based on this evidence, it is hypothesized to have an indeterminate relationship with the probability of value chain participation and market participation level.

4.4.3 Household size: Household size was captured as a continuous variable indicating the number of dependent people. More significant numbers of households mean more family labour for production. However, many households may increase consumption needs, which may reduce marketable surplus (Kyaw *et al*., 2018). Khoza *et al*. (2019) found that an increase in the number of households positively influences value chain participation and intensity of value chain participation, larger households have better chances to process or send more produce for agro-process as compared to smallholder farmers with fewer household members. In contrast, Honja *et al*. (2017) argued that increases in household size decrease the probability and level of value chain participation among mango producers in Boloso Bombe Woreda, Ethiopia. These findings align with Adenegan and Olorunsomo (2013), who indicated that increases in family size reduce marketable surplus because a more significant number of households consume more of what they produce. In this study, an indeterminate relationship between household size and probability of value chain participation and intensity of value chain participation.

4.4.4 Gender: This variable was a dummy variable. It takes 0 for male households and 1 for female households. Jalang'o *et al*. (2016) found no gender bias as both males and females have the same value chain participation opportunities. In contrast, the World Bank (2005) reports that women are marginalized from resources and denied opportunities that would enable them to move from subsistence farming to higher value chains in most developing countries. Rayes *et al*. (2012) argued that the gender of the farmer positively influenced the probability of value chain participation but had no influence on the level among potato farmers in Mozambique. Siziba *et al*. (2010) found that gender does not significantly affect the probability

and level of value chain participation among cereal farmers in Sub-Saharan Africa. In this study, gender and probability of value chain participation and level of value chain participation exhibited an indeterminate relationship.

4.4.5 Credit: This dummy variable takes 1 if the farmer has access to credit, and 0 otherwise. South African credit institutions prefer giving credit to farmers within economically active age groups who have proof of reliable income stream (Myeni *et al*., 2019). Usman (2016) found that access to loans would enable the financial capacity of the farmer to purchase quality farm inputs, thereby improving production and marketable surplus. Rahaman and Abdulai (2020) concluded that access to credit exerts a positive and significant influence on value chain participation. Similarly, Randela *et al*. (2019) indicated that access to credit had a positive and significant influence on farmers' likelihood to participate in the high-value cotton market. Farmers who access credit can pay for expenses associated with hiring labour for production and value-adding activities (Rahaman and Abdulai, 2020). Therefore, the variable was hypothesized to positively influence value chain participation and level of value chain participation.

4.4.6 Hired labour: Khoza *et al*. (2019) found a positive relationship between hired labour and value chain participation and a farmer's level of value chain participation. Smallholder farmers with hired labour are more likely to improve the value-added products sold on the market. These results are consistent with Musyoka *et al*. (2020), who found a positive relationship between hired labour and value chain participation among mango producers in Kenya. Musyoka *et al*. (2020) indicated that processing mango requires physical labour to perform different peeling, sieving, and packaging. Lefebo *et al*. (2016) argued that labour positively influences the intensity of value chain participation among bulla producers in Ethiopia's Hadiya zone. Thus, it is was hypothesized that hired labour positively influences value chain participation and level of value chain participation.

4.4.7 Market information: Access to market information improves the confidence of smallholder farmers who are eager to participate in a value chain. Sikwela (2013) argues that a farmer's value chain participation is positively influenced by access to market information. This may be because market information enables farmers to make informed decisions about the prevailing market conditions. The market information included was information on prices, quality, formal market requirements and other relevant information that could result in a farmer's participation in a value chain. According to Bienabe et al. (2004), access to market

information positively influences value chains and participation levels in value chains. This variable was hypothesized to positively influence the value chain and level of value chain participation.

4.4.8 Extension service: This dummy variable took a value of 1, if an extension worker visited the farmer in the past 12 months and 0 otherwise. Extension officers transfer information regarding agricultural production, marketing, innovations, produce processing (value addition activities) to farmers (Musyoka *et al.*, 2020). Forchu (2019) found that extension service positively and significantly influenced value chain participation and the level of value chain participation. Extension officers transfer new technologies to farmers (Danso *et al*., 2018). Zuwarimwe and Mbaai (2015) concluded that access to extension services positively and significantly influences value chain participation. In contrast, Alemu *et al*. (2011) argue that extension services negatively and significantly influence value chain participation and the level of value chain participation. This is because extension officers tend to focus more on production than processing activities. In the present study, extension service was expected to positively influence the value chain and the level of value chain participation.

4.4.9 Produce spoilage: Ricketts *et al.* (2014) found that produce spoilage negatively and significantly influenced value chain participation and level. Minten *et al.* (2021) found that produce spoilage negatively influenced both value chain participation and intensity among smallholder farmers in Ethiopia. These findings are consistent with Kumar and Underhill (2019), who indicated that postharvest handling practiced by smallholder producers significantly influences postharvest loss within the value chain, thus decreasing the marketable surplus. Therefore, a negative relationship between produce spoilage and value chain participation and the intensity of value chain participation was expected.

4.4.10 Livestock ownership and Land size: Moono (2015) indicated that farmers that own livestock can use them to plough for other farmers who do not own oxen to generate extra income, which can be used to buy farm inputs and packaging material. Livestock ownership was positively hypothesized to influence smallholder irrigators' value chain participation and value chain level. The size of the land is a continuous variable referring to the total area of the farmland the households owned or rented in and was captured in hectares. Land is a critical component in production.

4.4.11 Access to quality roads: Quality of roads determines accessibility to the value chain. A lack of quality roads delays the transportation of produce to the market. At the same time, quality roads can positively influence value chain participation. Mdlalose (2016) found that value chain participation and the level of value chain participation positively influence the quality of roads. Poor quality roads increase transaction costs and result in production damages, leading to a decrease in marketable surplus and intensity of value chain participation (Jari and Fraser, 2009). Therefore, it is hypothesized that access to quality roads positively affects value chain participation and the level of value chain participation.

4.4.12 Distance to market: Farmers further from the market centres are less likely to participate in the value chain because of higher transportation costs (Mdlalose, 2016). The variable was set as a continuous variable and was measured in kilometers. Kyaw *et al.* (2018) found that distance to the market had a significantly negative influence on the intensity of value chain participation. Therefore, a negative influence on value chain participation was expected.

4.4.13 Exchange of produce: The dummy variable assigned 1 if the farmer had exchanged produce and 0 otherwise. In this study, the exchange of produce was hypothesized to negatively influence both value chain participation and the value chain level because it decreases marketable surplus.

4.4.14 Training in value-adding: Access to training in value-adding was captured as a dummy variable whether the farmer received training in value addition or not. Access to training in value-adding greatly influences farmers' perceived knowledge and acquisition of the skills for value-adding activities (Musyoka *et al.*, 2020). These findings are similar to Adeyonu *et al.* (2016), who indicated that access to value-added training influenced value chain participation and the level of value chain participation positively among sweet potato producers in Kwara State, Nigeria. Therefore, access to value-adding training was hypothesized to influence smallholder irrigators' value chain participation and intensity positively.

4.5 RESULTS AND DISCUSSION

The socioeconomic characteristics of the smallholder irrigators are illustrated in Table 4.2 and the statistics are discussed below.

Table 4.2: Demographic characteristics of farm household in relation to value chain participation

Variable	Non-value chain participants		Value chain participants		
	n=93		n=150		
	Mean	**Std**	**Mean**	**Std**	**t-value**
Age	49.94	10.42	54.42	12.12	-4.74 ***
Hshldsize	3.41	3.19	8.25	4.24	-0.06

Source: Survey data (2020)

Note: ***: Significant at 1% level.

The sample revealed that 61.73% were value chain participants, while 38.27% did not participate. The average age among the participants was 57.42 years old, while the average of the non-market participants was 49.94 years old. This indicates that value chain participants were older than non-participants (Table 4.2). Therefore, these results are inconsistent with Musah *et al*. (2014), Bahta and Bauer (2012), and Nwafor (2020), who stated that value chain participation drops with age.

The average household size for non-value chain participants was 3.41, whereas the average of the value chain participants was 8.25. However, this difference was not statistically significant. Members of smallholder farming households in most areas of Africa are the primary source of farm labour.

Table 4.3 shows the gender distribution between value chain participants and non-participants. Seventy-nine percent (79%) of value chain participants were women, while 21% were male. On the other hand, 81% of non-participants were females and 19% were male. The results of the chi-square show that gender was not statistically significant. Reyes *et al*. (2012) argued that gender positively influenced market participation.

In contrast, the Food Organisation Association (FAO) (2010) reported a negative relationship between gender and market participation. According to FAO (2010), most smallholder farmers live in rural areas with gender inequalities concerning land rights. Therefore, gender bias results in difficulties in accessing the value chain.

Table 4 3: Gender of the household's heads

Gender	Non-value chain participants n=93		Value chain participants n=150		Overall	χ^2	Sig
	Freq	%	Freq	%	Freq		
Female ns	75	81	118	79	193	0.1375	
Male	18	19	32	21	50		
Total	93	100	150	100	243		

Source: Survey data (2020)

Note ns: = not statistically significant

Table 4.4 indicates that 54.67% of value chain participants had no formal education, 30.67% attended primary education, 14% attended secondary education and 0,67% attained tertiary education. On the other hand, 12.90% of the non-value chain participants had no education, 64.52% attended primary education, 22.58% attained secondary education and none attained tertiary education. Table 4.4 shows that 26.67% of the value chain participants accessed credit while 73.33% of the value chain participants did not. Numerous factors such as education and gender may influence access to credit. Dzadze *et al*. (2012) found that farmers with a higher level of education have higher chances of accessing and understanding information on credit terms and conditions and applying for loans. In addition, Yehuala (2008) and Obisesan (2013) stated that females find it difficult to obtain credit in agriculture. These results indicate that these factors influence the ability of many farmers in the schemes to obtain credit. This is because fewer farmers attained higher education and females are in the schemes.

Table 4 4: Farmers categorical demographic and institutional characteristics

Value chain participants		Non-value chain participants	Overall frequency
Variable	**n=150**	**n=93**	
	%	%	
		Education	
No education	54.67	12.90	94
Primary education	30.67	64.52	106
Secondary education	14	22.58	42
Tertiary education	0.67	0	1
		Access to credit	
Yes	26.67	27.96	66
No	73.33	72.04	177
		Access to market information	
Yes	78.67	34.41	150
No	21.33	65.59	93
		Transport reliability	
Yes	85.33	13.98	141
No	14.67	86.02	102

4.6 Market information

In order to be informed about the prevailing market conditions, a farmer needs to have access to market information. Mdlalose (2016) indicated that farmers who have access to market information are more likely to participate in the value chain than farmers who do not have information. Access to information strengthens farmers' negotiating skills during transactions with buyers, preventing probable exploitation by better-informed produce buyers (Kabeto, 2014). The lack of sufficient market information has led farmers to believe that wholesalers deliberately undervalue their produce on the formal market. This has led to a lack of trust between these actors, resulting in difficulties in a chain.

Table 4.4 indicates that 78.67% of the value chain participants have access to market information, while 21.33% do not have access to information. On the other hand, 34.41 % of the non-value chain participants have access to information, while 65.59% have no market information. One of the value chain participants argued that there was a year she produced a

good quality large beetroot after harvest. She approached SPAR, but it could not buy her produce because they were too large. SPAR required small sizes of beetroot because they are testier and were preferred by their customers. Therefore, this scenario proves that market information is vital from the production stage up to the final stage of the value chain consumer.

4.7 Transportation

Socioeconomic factors need to be understood first in smallholder farmers' value chain participation. Smallholder irrigators in South Africa are located in remote areas distant to market points (Usman, 2016). Therefore, reaching the market can be challenging. Unreliable transport can lead to delays. As a result, transport reliability becomes increasingly crucial for smallholder farmers. The results in Table 4.4 show that 85.33% of the value chain participants have reliable transport that moves their produce to market.

In contrast, 14.67% of the participants have unreliable transport. Only 13.98% of the non-value chain participants had access to reliable transport and 86.02% had no access to reliable transport. Although public transport may be available, the challenge is reliability since sometimes it does not show up. Consequently, transportation reliability in a value chain is essential, as some produce is highly perishable and must be moved immediately after harvest.

According to the study, 50% of the participants in the value chain use three different modes of transport to move their marketable surplus. These modes include public transit, hired transport and buyers' transport. In contrast, 41.33% of farmers transport their produce via buyer's transport to the market. Only 8.67% of value chain participants reported using their vehicles to move their agricultural produce from the farm to the market. These findings are in line with Mdlalose (2016) who argued that smallholder farmers in South Africa end up selling their produce locally (local shops and neighbours) at a lower price due to the lack of transportation. Smallholder producers are forced to depend on public transport or hire unreliable vehicles. Transport ownership motivates farmers to produce surplus and participate in the value chain because they own transport (Kabeto, 2014). About 9.3% of farmers reported working on plans to get cheap modes of transport such as motorbikes and bicycles. This will minimize the cost of transportation and increase their level of participation in the value chain.

4.8 Road infrastructure

Different types of road infrastructure services farmers from MRIS and TGFIS. The results indicate all the farmers in the irrigation schemes have access to roads. However, only 10.70% are serviced by tar roads. Farmers serviced by tar roads argued that potholes were the problem because they damaged produce when transported to the market. Therefore, due to this a farmer is forced to drop a price for product and some are rejected in the marketplace because of damages. This signifies that road infrastructure in the study area is still poor. According to 67 percent of respondents from value chain participants, poor road infrastructure causes transport costs to increase continuously, discouraging other farmers and causing others to quit. These findings are similar of what has been discussed in the literature review. Furthermore, 60.91% of the farmers indicated that during rain seasons, roads are inaccessible. These findings are similar to Mdlalose (2016) who indicated that 35% of farmers in Msinga have poor access to good roads.

4.9 Credit

Apind (2015) indicated that access to credit is necessary for acquiring inputs and the payment of casual labour. Similar Kosgey (2013) argued that credit makes small-scale farming more productive by purchasing farm equipment and introducing modern technology and irrigation systems. About 27.96% of the non-value chain participants took credit and 72.04% had no access to credit. Most credit institutions charge higher interest rates and require credit to be repaid quickly. This may explain the lower number of value chain participants that have taken credit. Therefore, farmers prefer not to rely on credits.

Table 4.5 shows that 19.70% of the farmers who obtained credit from relatives/ friends, 46.97% received credit from money lenders. In comparison, 25.76% obtained their credit from stokvels. Some 1.51% of farmers received credit from produce output buyers. Lastly, 6.06% received their credit from financial institutions.

Table 4.6 indicates that 54.55% of the smallholder irrigators obtained their credit for purchasing farming inputs. About 19.70% acquired credit for hiring farm labour, while 12.12% of farmers acquired credit for renting plots. The results indicate that 10.60% obtained credit specifically for purchasing agricultural machines. Only 3.03 percent of the respondents obtained credit for the study's value addition and marketing purposes. Smallholder farmers have not invested enough in the crop activities of value-adding that will improve their crops' marketability and allow them to charge higher prices for their products. Therefore, these results

indicate that smallholder farmers put more effort into the production phase than other value chain stages. These findings are similar to Apid (2015), who argued that only a minority of smallholder farmers practice value-adding for their postharvest produce.

Table 4.5: Source from which credit was acquired

Credit institution	Percentage (%)
Relative/friend	19.70
Money lender	46.97
Stokvel	25.76
Output buyer	1.51
Financial institution	6.06
Total	**100**

4.10 Empirical results

A study analyses the determinants of smallholder irrigators' participation in the agricultural value chain and level of participation using a double-hurdle model. From eleven explanatory variables included in model five were statistically significant in determining the value chain participation. The variables included in the model were: age, education, household size, gender, access to credit, hired labour, market information, extension service, produce spoilage, access to road and livestock ownership. The coefficient sign shows the type of influence of the variable on the Probit (Positive or Negative). Therefore, if the coefficient value is positive, there is a positive relationship between the dependent and independent variables. Table 4.7 presents the econometric results from the Probit regression.

Table 4.6: Purpose of the acquired credit and the credit institutions

Credit purpose	Percentage (%)
Purchasing inputs	54.55
Hire labour	19.70
Renting plot	12.12
Purchase agricultural machine	10.60
Output marketing	3.03
Total	**100**

4.11 Significant variables

Age, access to credit, extension service, roads, and livestock ownership significantly influence value chain participation. Musah (2013) reported that value chain participation declines with age, as older farmers are more susceptible to risk aversion and conservative attitudes. Shabangu (2016) found that access to credit enables farmers to improve their farming technologies by using mechanized agriculture and modern fertilizers. Therefore, farmers can comply with the standards that the market has set. In addition, extension services play an essential role in empowering farmers with knowledge, farming techniques, and management skills. Hence, extension service provides crucial information to farmers regarding agricultural interventions such as farm production technologies, marketing, and processing equipment (Chauke *et al*., 2013). Lack of reasonable road connectivity delays in moving agricultural produce to market centers, quality and quantitative losses of produce, and transaction costs, which act as an impediment to farmers and result in poor value chain participation (Birthal and Joshi, 2009). Therefore, good roads enable farmers to participate in the value chain.

4.11.1 Age

Table 4.7 indicates that the age of the household was statistically significant at a 10% level and positively influenced value chain participation with a marginal effect of 0.525. This implies that as the age of the household increases, the probability to participate in the value chain increases by 52.5%. This could be attributed to the fact that as the farmers grow older, they gain more experience, connections, and confidence, minimizing transaction costs and improving value chain participation. This is supported by Abafe (2021), Nkoana *et al*. (2019), Mdlalose (2016), Randel *et al*. (2008), and Matungul *et a*l. (2001), who concluded that

older farmers are more experienced and tend to understand market requirements, allowing them to trade at a lower transaction cost. The result of this study opposes that of Mashaya (2021), who indicated that older farmers are less likely to be value chain participants because they are more concerned about being food secure.

Table 4.7: Probit estimates of factors influencing smallholder irrigators participation in value chain

Variable	coefficient	std.error	Significance	Marginal effect
Age	.0225357	.0136786	0.099*	0.525
Education	-.1319345	.19282	0.494	0.619
Household size	.0024463	.0349415	0.944	0.607
Gender	.1554257	.3595518	0.666	0.605
Access to credit	2.30729	.3037071	0.000***	0.849
Hired labour	.0986355	.2743063	0.719	0.615
Market information	.3131131	.2900829	0.280	0.624
Extension service	.8744826	.2876984	0.002***	0.667
Produce spoilage	-.5837781	.7334746	0.426	-0.606
Access to road	.7465958	.3466112	0.031**	0.684
Livestock ownership	1.423486	.3065433	0.000***	0.686
_cons	-3.244886	1.106481	0.003	

Note: *, * represent significance level at 1% and 10%, respectively.**

LR chi2=212.23

Prob>chi2=0.000

Pseudo R2=0.6544

Log likelihood= -56.04258

Source: Survey data (2020)

In contrast, younger farmers want to increase their quality of life by acquiring life-enhancing material, therefore engaging in the value chain. Similarly, Hlatshwayo *et al*. (2021) and Chalwe (2011) argued that as the farmer gets older, the probability of participating in the agricultural value chain is decreased. This could arise because older farmers are at risk of being adverse and have conservative attitudes.

4.11.2 Access to credit

Access to credit indicated a positive influence on value chain participation and was statistically significant at a 1% level with a marginal effect of 0.849. With an increase in access to credit, the odds of a farmer participating in a value chain increase to 84.9%. Thus, the positive outcome of access to credit implies that farmers who had access to credit were more likely to participate in a value chain. This implies that access to credit positively increases the volume to purchase improved seeds, ensuring farmers have access to assets to meet market demands, expand operations and invest in value-adding. The result of this study substantiates the findings of Mirie and Zemedu (2018), and Cheteni and Mokhele (2019), who indicated that access to credit improves agricultural production and productivity through the use of improved agricultural technologies. Therefore, the probability of participating in the value chain is improved. The result is also consistent with Majokweni (2018) and Hlongwane *et al*. (2014), who acknowledged that access to credit guarantees that farmers can secure inputs, resulting in improved farm revenues. Lastly, Lerman (2004) stated that for smallholder farmers to be commercialized and compete equally with an established farmer in the value chain, access to credits needs to be improved since it is a challenge for small-scale farmers.

4.11.3 Extension service

Farmers are often informed about the new technologies through extension services and trained on how to apply them, counter the negative effect of a lack of education on adoption. Results of the study indicate that extension service was statistically significant at 1% and positively influences value chain participation with a marginal effect of 0.667. The result implies that if smallholder irrigators have access to extension service, the probability of participating in the agricultural value chain improves. This can be attributed to the fact that extension officers provide smallholder farmers with technical advice on the seed's farmers use in different seasons to ensure a quality product, agricultural information, and skills that are important for farmers to be value chain participants (Loki *et al*., 2019 and Cele and Wale, 2020).

These findings align with that of Wale *et al*. (2021), Baiyegunhi *et al*. (2019), and Majokweni (2018), which acknowledged that access to extension services improves farm performance in terms of increasing crop revenue. Therefore, increased crop revenue results in quality access of farm inputs, productivity, and value chain participation. This estimation is consistent with the study expectations, which hypothesized a positive relationship between extension service and value chain participation. The result is inconsistent with the work of Von Loeper *et al*. (2016) and Nyawo and Mubangizi (2021), in which they argued that extension officers play a minor role in disseminating market information to the smallholder farmers to ensure that they participate in the value chain, extension officers scarcely visit their allocated villages and the educational levels of such officers remain low.

4.11.4 Access to road

Access to roads showed a positive impact on the probability of a farmer value chain participation and it was significant at a 5% level. As depicted by the marginal analysis, the implication of the finding indicates that as access to roads increases by a unit, value chain participation increases by 0.684, provided that the other variables are held constant in the model. This may be because, when roads infrastructure is well improved, transportation costs that are identified as one of the challenges in small-scale agriculture are expected to drop. Hence, an increased volume of produce to be transported reduces produce damage. Therefore, it enables farmers to deliver their produce well and enhances value chain participation.

The finding is in line with the study conducted by Mthembu (2008) and Kekana (2017), who revealed that good roads prevent spoilage due to road accidents and the inability of vehicles to reach farm locations due to bad roads and minimize transaction costs. Cheteni and Mokhele (2019) also found that road access positively affects the probability of participating in the value chain. Lastly, the finding of this study supports the study of Acheampong (2016), who posited that financial institutions would not invest in areas with difficult road access and extension officers would not be able to extend their training programs to inaccessible areas.

4.11.5 Livestock ownership

Ownership of livestock had a positive coefficient and was statistically significant in affecting the probability of value chain participation. As shown by the marginal analysis, the implication of the outcome indicates that as livestock ownership increases by a unit, value chain

participation increases by 0.686. The reason behind this may be because ownership of productive assets such as oxen which are used for direct production, increases the size of the land that can be planted and minimizes the cost of hiring a tractor by the household, thereby increasing the chances of producing a marketable surplus (Moono, 2015). This result contradicts the findings of Kyaw *et al*. (2018) and Makhura (2002), who found that owning livestock implies that household members will devote more time to livestock production and share money with livestock for feeding them and less focus on value-adding. Therefore, resulting in a decrease in value chain participation.

4.12 Types of value-adding practiced by farmers

Farmers involved in value chain activities are referred to as value adders. The level of value chain participation was measured by the number of activities each farmer is involved in as some farmers do not participate in some activities. Therefore, value-adding activities represent farmers' extent of value chain participation. The agricultural value chain comprises many benefits, but it is difficult for smallholder farmers to realise them. Farmers must undergo different value chain stages to accomplish all these benefits (Namulindwa, 2018). Some farmers participated in a few value chain activities whereas others performed in many activities. Usually, there are three common marketing destinations for smallholder farmers in South Africa: informal markets, fresh produce markets, and supermarket chains. The three destinations have different requirements for farmers to supply them (Ntshangase, 2014).

Value chain activities involve the change of the primary product into one that has added value. Usman (2016) reported that the simplest value-adding activities for smallholder farmers are cleaning, grading, and bulking. The survey results found that 81.6% of farmers wash and clean their produce, and 96.2% indicated that they sort their produce based on size. Some 60.6% of market participants pack their produce into packs. Musyoka (2020) noted that sorting and packaging are key elements in a value chain because they can increase value by 40-60% while ensuring safe handling.

Furthermore, produce sold to supermarkets was labeled and packaged. Farmers who undertook various value chain activities understood the higher returns achieved when participating in different activities and supplied their produce to formal markets. At the same time, those farmers who performed the most negligible value chain activities were likely to sell their produce in informal markets. These findings reveal that the level of value chain participation is different amongst farmers.

4.13 Factors influencing level of value chain participation

Different factors often influence the extent of value chain participation among smallholder farmers. McDonald and Moffit (1980) stated that coefficients of Tobit are interpreted similarly to OLS regression coefficients; however, the linear effect is on the uncensored latent variable, not the observed outcome. The determinants of the extent of value chain participation were estimated using the Tobit regression model involving twelve regressors. The results presented in the table show that seven factors, age, hired labour farm, livestock ownership, land size, credit access, exchange of produce, and value-adding training were significantly influencing the extent of smallholder irrigators' value chain participation**.** This model has been previously used by Alkali (2017). The results show a Log-likelihood of 88.414835 and chi-square of `1786.91.

Table 4.8: Factors affecting level of value chain participation

Variable	**Coefficient**	**Standard Error**	**P>|t|**	**z-statistic**
Age	.0023585	.0012604	0.063*	1.87
Gender	-.0106246	.0262392	0.686	-0.40
Education	.0224289	.016077	0.164	1.40
Household size	.0037863	.0038999	0.333	0.97
Livestock ownership	.0012297	.0005351	0.022**	2.30
Land size	.0038284	.0052466	0.025**	0.67
Labour	.8523305	.02721	0.000***	31.32
Credit access	.0502908	.0278808	0.073*	1.80
Access to road	-.0018465	.0256017	0.943	-0.07
Exchange of produce	-.1898492	.0358928	0.036**	-3.95
Produce spoilage	-.0293458	.0515378	0.569	-0.57
Train value add	-.0283244	.044747	0.072*	3.14
Cons	.0277829	.0671847	0.632	0.41

LR chi 2(13) = 1345.71; Prob>chi2= 0.1000, Log likelihood= 68.4133858; Note: ***, **, * represent significance level at 1%,5% and 10%, respectively.

Source: Survey data (2020)

4.14 Significant variables

Age, livestock ownership, land size, labour, credit access, exchange of produce, and training in value-adding significantly influenced the level of value chain participation. Rahman *et al.* (2016) indicated that there is a negative relationship between age and level of value chain participation due to the inability of old-aged farmers to access information and marketing. In contrast, Rabbi, (2019) reported that older farmers are more experienced and are aware of changes in weather and pesticide use. Livestock enables farmers to produce a more considerable amount and supply a more significant proportion of the output since farmers cultivate their land by using oxen (Zamasiya *et al*., 2014). In addition, Achandi and Mujawamariya (2016) reported that farmers cultivating large farm sizes can produce the necessary surplus to sell to the market because higher yields boost the farmer's likelihood of participating in the value chain surplus their household consumption needs. By having more farmworkers, the possibility of generating a more marketable surplus is increased and the intensity of value chain participation. Marketable surplus decreases as a result of produce exchange. Lastly, Gwivaha (2015) indicated that for smallholder farmers to succeed in the agricultural value chain, training should be prioritized because it increases agricultural production, increasing value chain participation.

4.14.1 age

The results in the study showed that age positively influences the level of value chain participation and is statically significant at the 10% level. This implies that a one-year increase in the farmer's age also results in an increase of value chain participation by 6.3%. This result shows that older farmers have more experience and their farms are well organized; therefore, producing more yield and level of value chain participation improves. This finding is in line with the study of Beadgie and Reddy (2020) who found that older farmers are wise in resource use and management. Hence, as the farmer gets older, the likelihood of value chain participation increases.

On the contrary, Demeke (2014) found that the age of the household negatively influences the level of value chain participation. Supporting the argument, Demeke (2014) indicated that older households have limited access to market information, whereas younger farmers could sell a relatively large portion of their produce through better access to price information. Similarly,

Mbitsemunda and Karangwa (2017) stated that older farmers are risk-averse and their willingness to adopt technologies is less, which causes a low level of value chain participation.

4.14.2 Livestock ownership

Livestock ownership indicated a positive influence on value chain participation and was significant at a 5% level. The positive outcome of livestock ownership implies that owning livestock contributes positively to value chain participation among value chain participants. This could be attributed to the fact that farmers who own livestock would have a higher probability of getting excess livestock for selling to buy inputs for production, mainly the household of more oxen can plough more land on time, thereby attaining crop yields which will increase the marketable surpluses. The results are consistent with Yohanes (2015) and Esmael *et al*. (2017) who stated that livestock is one of the most important assets for farmers and can be used as an alternative source of income and as a means of transportation that reduces transportation costs. In contrast, Musyoka *et al.* (2020) stated that an increase in the number of livestock owned by farmers might result in competition for resources. Therefore, farmers might end up shifting their concentration more on livestock rather than other farm-level value addition activities.

4.14.3 Land size

The study results show that land size positively influences value chain participation and is statistically significant at a 5% level. This implies that the level of value chain participation would increase as the land size utilised by farmers increases. An increase of 1 hectare in land owned resulted in an increased quantity of produce sold off-farm by 2.5 percent. The results concurred with Geremewe (2019) and Kalaubi (2021), who revealed that extensive farmland enabled the household to produce a surplus for the market. The findings collaborate with Maponya *et al*. (2017) and Dlamini (2019) report that, larger farm size enables farmers to plough more. Therefore farmers produce beyond household food consumption needs and sell more surplus to the market. The results also substantiate the findings of Yohanes (2015), Honja *et al*. (2017) and Mbembe (2020) who acknowledged that large size of land increases yield than small size farms, which in turn increases farmers probability of being a seller and level of value chain participation. The findings are contrary to Mbitsemunda and Karangwa (2017) and Randela and Groenewald (2008), who found that larger land size negatively influences the level of value chain participation.

4.14.4 Labour

The study found that hired labour positively influenced value chain participation and was significant at the 1% level. The positive sign indicates that as farm labour increases, the level of value chain participation increases. This was ultimately expected and corroborates the finding of Rubhara and Mudhara (2019) finding that adding a person to the labor force leads to an increase in value chain participation since labor increases generated a marketable surplus. These findings are also similar to the study of Mmbando (2014), who affirmed that farmers with a larger labour force could cultivate more significant areas of land and produce more surplus to market and that will increase level of value chain participation since the processing of produce requires physical labour input to perform different activities of the value chain such as packaging.

4.14.5 Credit access

Access to credit showed a positive effect on value chain participation and was statistically significant at a 10% level. This implies that having access to credit positively contributes to the value chain level among value chain participants. This result is expected since access to credit enables farmers to produce more output because credit provides capital for farmers to spend on the input market that improves yield. The finding is consistent with Koatla (2012) and Musah (2013), who found that access to credit provides financial strength for farmers to engage in intensive farming, resulting in a more marketable surplus. Similarly, Usman (2016) argued that most parts of value addition by farmers are conducted during financial shortage times that require money. As a result, farmers who have access to credit participate in value addition and increase the volume sold. Lastly, Mbitsemunda and Karangwa (2017) indicated a significant positive relationship between credit access and level of value chain participation.

4.14.6 Exchange of produce

The results revealed that the produce exchange was negative and statistically significant at a 5% level. This implies that smallholder irrigators who exchange their produce with other commodities such as woods and livestock, e.g., chickens had lower chances of selling their produce by 10.4% than those who did not exchange. Makonese *et al*. (2018) indicated that over 600 million people in Africa depend on traditional energy sources to meet their basic energy needs. Bailis *et al*. (2007) stated that Sub-Sharan Africa (SSA) region has the lowest total Gross Domestic Product (GDP) and GDP per capita in the world. In addition, 90% of rural households depend on wood as their primary fuel for cooking and heating across the SSA region. Therefore, smallholder farmers exchange their produce for other commodities such as wood and livestock due to these concerns. Hence, reducing production and decreasing the quantity of produce sold decreases value chain participation. Lastly, lack of storage also forced farmers to exchange their produce for other commodities immediately after harvest.

4.14.7 Training in value-adding

The results show that training in value-adding had a negative and significant influence on the level of value chain participation. This implication of the findings shows that training in value-adding negatively affects value chain participation. The result is unexpected since training improves households' technical skills that can help them produce quality products and increase the volume sold (Rugema *et al*., 2018). A possible explanation for this might be that farmers are unexposed to value-adding training, limiting value chain participation. These findings align with Akrong *et al*. (2021), who indicated that some extension workers do not train farmers properly. They sometimes provide farmers with sophisticated technology and inputs without any training.

Similarly, Koatla (2012) also found that most extension officers are unable to deliver what is expected from them. This is worsened by the fact that the extension officers do not have an adequate background in market intelligence. Montshwe (2006) suggested that it is recommended that, as a way of improving the level of value chain participation of smallholder farmers in the formal markets, extension advisors undergo a program that entails revitalization of new skills development, particularly in the area of marketing.

4.15 Conclusion and recommendation

The study investigated the factors affecting smallholder farmers' value chain participation and its level using primary data collected among 243 randomly selected households in Msinga Local Municipality, KwaZulu-Natal Province. The double-hurdle model was applied to estimate whether to participate in the value chain or not and determine the quantity of produce sold. The model results indicate that age, access to credit, extension service, access to roads, and livestock ownership significantly influenced smallholder farmers' agricultural value chain decisions. The empirical results further showed that age, livestock ownership, land size, labour, credit access, exchange of produce, and training in value-adding significantly influenced the intensity of value chain participation.

The study recommends that policies should account for these socioeconomic and institutional factors to improve value chain participation and farmers' level of value chain participation. Therefore, government institutions and policymakers must clearly understand these factors before implementing policies and interventions to improve smallholder farmers' value chain participation. Government interventions should use a bottom-up approach.

Access to credit positively affected value chain participation and intensity value chain participation. Therefore, access to credits need to be improved and this can be achieved through capacitating smallholder farmers with production and financial management skills. One of the reasons why formal banking institutions fail to give credit to smallholder farmers on a sustainable basis is that they consider smallholder farmers incompetent. As a result, they are unable to utilize credit effectively. Therefore, government-created institutions may be helpful for capacitating farmers with production and financial management skills. Hence, this will assist farmers in using their credit more effectively and efficiently. Therefore, if lending institutions can discover that smallholder farmers are more sustainable and can repay the credit, there is no doubt that they will continue providing smallholder farmers with financial assistance. South African government should explore funding partnership approaches from the private sector through the Department of Agriculture, Land Reform, and Rural Development, mainly through blended finance programs.

Infrastructure investments have not reached all rural areas in South Africa. Therefore, the South African government needs to improve bridges and roads. Having reliable road networks allows producers to easily move their product to favourably marketed markets without being hindered

by weather conditions. The lack of machinery and packhouses is why smallholder farmers do not complete all tasks along the value chain, such as cleaning, packing and processing. Therefore, most smallholder farmers end up only participating in primary production. Hence, the government should implement policies and conditions favourable to smallholder farmers' development. This will enable smallholder irrigators to access different marketing channel opportunities and minimize the loss of income through produce spoilage and forced low price sales.

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CHAPTER 5: FACTORS AFFECTING THE PROFITABILITY OF SMALLHOLDER IRRIGATORS

ABSTRACT

Smallholder irrigation farming has become an excellent income-earning occupation for rural households. This paper aimed to identify factors affecting the profitability of smallholder irrigators in Tugela Ferry and Mooi River Irrigation Schemes located in Msinga Local Municipality, KwaZulu-Natal Province. The results of the gross margin analysis suggest that smallholder irrigators are profitable on average. A total of 243 smallholder irrigators were randomly selected from two schemes. This study found that age, land size, access to credit, extension service, packing, and tractor hire significantly influence profitability.

The study proposes the formation of commodity groups. Grouping farmers into groups makes it easier to access more lucrative markets and minimize transaction costs. Commodity groups can serve several functions, such as taking joint responsibility for credit, arranging for the delivery of inputs, and the collection of produce after harvest. Organized groups can facilitate the delivery of training and extension services.

Keywords: smallholder irrigators, profitability, Gross margin, Multiple linear regression

5.1 Introduction

The main objective of business enterprises is to get profit after subtracting all of the expenses they incurred from their generated revenues (Mdoda, 2017). The ability to generate positive net revenues is the vital point of farmers' sustainability and success. The agricultural sector contributes towards major African priorities, such as alleviating poverty, boosting intra-Africa trade and investments, and creating jobs (Toringepi, 2016). The majority of the population in developing countries engage in the agricultural sector to earn their livelihood. However, smallholder farmers face different constraints in their farming efforts (Terefe and Gemechu, 2016). Fan *et al*. (2013) indicated that the geographical dispersion and poor infrastructure in rural areas drive up transaction costs, lower farmers' profit margins, and result in many farmers pursuing subsistence-oriented production practices.

Kebede *et al*. (2017) argued that even though smallholder farming is an essential contributor to poverty alleviation, different challenges, including low yields, produce loss, poor quality of agricultural produce, lack of credit, and markets, impede the production of smallholder production. Similarly, Andrews and Pemberton (2014) indicated that low farm profitability is a significant concern of third-world countries because it negatively affects food security by limiting food supply and access to food by rural people due to low farm incomes. Mujuru and Obi (2020) argued that smallholder farmers consume the bulk of their farm output in rural parts of developing countries, limiting their participation in output markets and realizing financial gains. Therefore, without being profitable farmers, cannot survive in a value chain for an extended period. The chapter presents the main findings on analytical tools employed to determine the gross margin of the crops grown by smallholder irrigators in Tugela Ferry and Mooi River Irrigation Schemes. This chapter lastly gives the multiple linear regression, which determines the factors affecting the profitability of smallholder irrigators.

5.1 Research methods

5.1.1 Study area

The data were collected from two irrigation schemes in Msinga Local Municipality located in KwaZulu-Natal (KZN) Province of South Africa, i.e., Tugela Ferry and Mooi River Irrigation Schemes. Subsistence agriculture in Msinga is still primarily practiced for subsistence, and poor soil quality, adverse climatic conditions, and poor technologies are limiting factors (Msinga Municipality, 2018). A sample of 243 households was collected in the two irrigation schemes. Chapter 3 presented the characteristics of the study area.

5.1.2 Data collection procedure

The data collection procedure for this chapter was similar to the one described in Chapter 3, Section 3.3.2

5.2 Conceptual framework

Farmers are heterogeneous in characteristics. The characteristics have an impact on the profitability of the farm. Figure 5.1 illustrates the profitability conceptual framework.

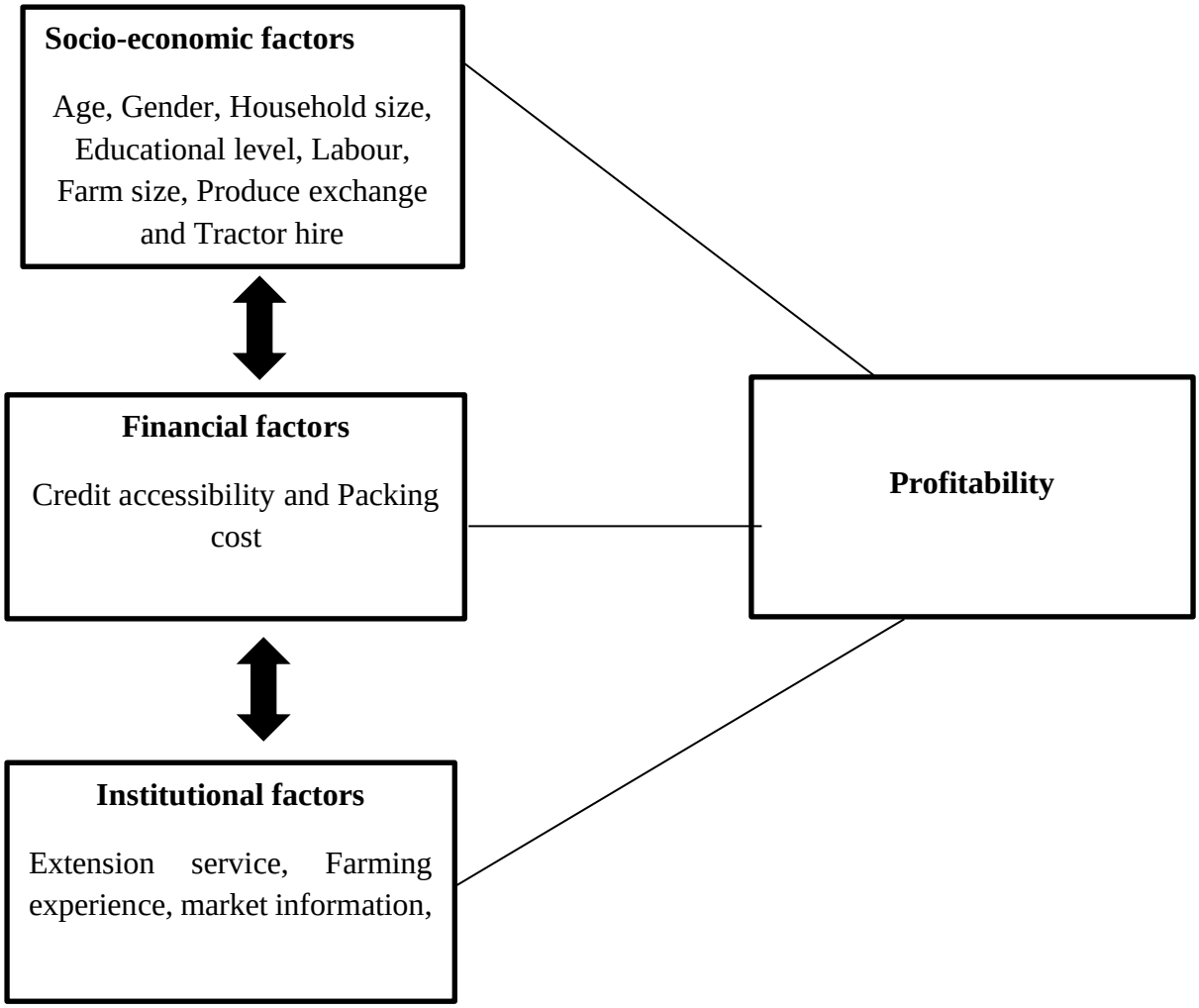

Figure 5.1: Conceptual framework of profitability

Source: Authors own construction

A conceptual framework is the researcher's idea on how the research problem will be tackled (Andrew and Philip, 2014). The conceptual framework in Figure 5.1 shows factors that influence the profitability of smallholder irrigators. Profitability was the dependent variable and the independent variables were factors. These two variables were chosen to see the relationship that exists between them. It was conceptualised from the framework that there was a correlation between the factors and profitability. The amount of income earned from produce determines the profitability reaped by the farmers.

5.3 Data analysis method

The study analyzed profitability using gross margin budgeting. Gross margin is defined as the difference between the value of an enterprise's gross output and variable costs. Chirigo (2014)

used gross margin analysis to analyse the economic competitiveness of green maize production in a smallholder irrigation scheme. A multiple regression model was used to analyse factors affecting the profitability of smallholder irrigators. Multiple linear regression is a model with more than one explanatory variable. Rugube *et al*. (2019) used the model to investigate factors affecting the profitability of smallholder vegetable farmers in the Shiselweni Region, Kingdom of Eswatini (Swaziland).

The following formula was used to calculate the gross margins:

GM= GR-TVC

Where: GM= gross margin (ZAR/ha)

GR was the gross revenue calculated as the price per unit output and the amount produced (kg quantity produced).

TVC is the variable costs associated with the production of the product

Components of the TVCs included the inputs (land preparation, fertilizers, seeds, agrochemical, land rental, labour (hired), packaging, harvesting, and marketing cost.

Hence, gross margin per hectare is used as a proxy for profitability. The regression model is shown below:

Y= is a dependent variable, in this case, profitability (profits/ha)

$Y = \beta X$

βί (ί=1…..Ɍ)=Regression coefficients

Xί (ί=1…..Ɍ)= Independent/explanatory variables

β_0= is the constant or intercept

Profitability determines the success or failure of the farming enterprise. Table 5.1 shows the variables used in the study to examine the determinants of profitability.

Table 5.1: Hypothesized factors influence farm profitability

Variables	Variable description	Expected sign
Age	Age of the household in years	+
Gender	Gender of the household	+/-
Education	Level of education of the household	+
Farm size	Land size owned by the households in hectares	+
Household size	Family size in persons	+
Credit accessibility	Access to credit	+
Hired labour	Hired labour	+
Market information	Access to market information	+
Extension service	Access to extension service	+
Packing	Packaging produce	+
Produce exchange	Produce exchange	-
Farming experience	Number of years	+
Tractor hire	Use of mechanical power	+

5.4 Explanations of variables used in the study

5.5.1 Age and experience of farmers: Wango (2016) stated that age represents the level of knowledge that the farmer has supposedly gained. Farmers with more experience could have already been aware of different markets and primary agriculture. Therefore, the variable was expected to influence the net benefits of a farmer positively. Chirigo (2014) argued that the older the farmer, the more the possibilities of the farmer to be successful because older farmers have relatively richer experiences of the social, economic, and physical environments surrounding the farming environment. In contrast, Venance *et al*. (2016) found a negative relationship between age and farm gross margins. Entrepreneurship declines as the age of the farmer increases, and the ability to practice manual work declines with age.

5.5.2 Gender: This study hypothesized an indeterminate relationship between gender and farm gross margins. Hart and Aliber (2011) reported a negative relationship between gender and farm gross margins. Ghambi (2015) argued that female-headed households could generate less gross margins than male-headed households because of spending more time on social roles

such as weddings, funerals, and household responsibilities, i.e., cooking and fetching water instead of doing productive farm roles.

5.5.3 Education: Education is essential for adopting technology, which is critical for agricultural practices and management and hence, improving the yield of a farmer and profits (Ferreira, 2015). Education makes farmers innovative and easily understand the concept taught in different training courses. Therefore, educated farmers have better chances to adopt information (Kasonga, 2018). Following this argument, education was hypothesized to influence gross margins positively.

5.5.4 Farm size: The farm's size was expected to influence the gross margins positively. The bigger the land available to the farmer, the higher the chances to diversify to increase the quantity of agricultural produce available for sale (Mdoda, 2017).

5.5.5 Household size: A positive relationship was expected between household size and gross margins of smallholder farmers since household members can be used as the source of labour for the family farm. Takane (2008) indicated that family members are the immediate source of labour in smallholder farming. In contrast, Birachi *et al*. (2011) indicated a negative correlation between household size and farm gross margins. Household size increases produce consumption, thus decreasing the agricultural produce available for sale.

5.5.6 Credit accessibility: A positive relationship was expected between credit accessibility and gross margins. Access to credit improves the financial capacity of the farmer to purchase farm inputs. Venance *et al.* (2016) found that access to credit positively influenced the profit margins. Credit enables innovative technologies and drives output marketing activities, which ultimately improves gross margins for farms.

5.5.7 Labour: A positive relationship between labour and gross margins was expected. Libago (2017) found a positive relationship between labour and farm gross margins. It could be because hired labour is experienced and effective in assigned tasks (Kanyua et al., 2015). In contrast, Manzvera *et al*. (2019) indicated that increased labour results in less gross margins.

5.5.8 Market information: This study hypothesized a positive relationship between market information and gross margins among smallholder irrigators. Manzvera *et al*. (2019) found that access to market information significantly and positively influenced the gross margins among groundnut producers in Zimbabwe. Smallholder farmers who have access to information have

higher chances of negotiating and bargaining with middlemen and selling their agricultural produce at higher prices.

5.5.9 Extension service: Extension service was expected to influence gross margins positively. Extension officers assist farmers with training, which equips them with improved technologies and innovation that increase their gross margins (Mdoda, 2017). Similarly, Oband (2012) indicated a positive correlation between extension service and gross margins.

5.5.10 Exchange of produce: The exchange was expected to influence gross margins because it decreases marketable surplus negatively.

5.5.11 Tractor hire: Sambrook (2005) argued that farmers hiring tractors instead of using hand-hoes are more advantageous in terms of land cultivated, crop diversity yields, levels of drudgery, and marketable surplus. Therefore, smallholder farmers can cultivate up to eight hectares a year and increase profits by hiring tractors. In this regard, tractor hire was hypothesized to influence smallholder irrigators' gross margins positively.

5.6 Gross margin analysis

Table 5.2 presents the gross margin results of the Tugela Ferry and Mooi River Irrigation Scheme. Study results are based on harvests obtained by farmers and production costs for irrigators. The farmers' main variable costs in the study area identified include fertilizers, land preparation, land rental, transportation, packing material, seeds, agrochemicals, labor, and harvesting. The gross margins were for each farmer that was a value chain participant. Table 5.2 shows the profitability of crop enterprise among smallholder farmers.

The positive results of gross margin indicate that smallholder irrigators in Tugela Ferry and Mooi River Irrigation scheme generate sufficient income, on average, to sustain their livelihoods. The positive results reveal that smallholder irrigators can pay back credits after selling their produce since they are profitable. This also reveals that smallholder irrigators can cover their variable production costs and invest in quality agricultural inputs. The tomato enterprise has the highest gross margins for farmers in the schemes, followed by cabbages. Beans have the lowest gross margins in the schemes. Even though tomatoes are more profitable than other enterprises, they require high maintenance, high labor demand, and are very expensive. Therefore, some of the farmers in the schemes preferred not to produce it. Finally, the tomato was considered the most significant cash crop in the study.

Table 5.2: Profitability of crop enterprises among smallholder irrigators

	Potatoes (ZAR)	**Tomatoes** (ZAR)	**Cabbage** (ZAR)	**Maize** (ZAR)	**Beans** (ZAR)
Gross income	**20 680.00**	**27 869.00**	**21 920.00**	**16 915.15**	**12 980.00**
Land prep	2100.00	2 150.00	2150.00	1460.00	1000.00
Seeds	1890.80	2 920.90	2100.90	1760.00	660.90
Fertilizers	960.00	1 490.00	920.00	816.90	710.00
Agrochem	816.00	4 860.20	1370.30	620.00	300.00
Pack material	1360.60	650.00	360.00	0	115.00
Land rental	920.00	1000.00	1000.00	920.00	320.00
Labour	1780.00	2 100.00	1460.00	1250.50	1020.00
Trans cost	950.00	1 200.00	1380.00	690.00	720.00
harvesting	780.00	1 280.00	920.00	1100.00	1370.00
Total VC	11 557.40	14 061.10	11 661.20	8 617.40	6 215.90
Gross margin	**9 122.60**	**13 807.90**	**10 258.80**	**9 297.75**	**6 764.10**

N=150

Source: Farmer survey (2020)

5.7 Factors affecting the profitability of smallholder irrigators

Multiple linear regression was employed to identify factors affecting the gross margins of smallholder irrigators. The multiple linear regression results indicate that the estimated F-ratio was statistically significant at 1%. Six variables were found to affect the profitability of

smallholder irrigators. The explanation of factors influencing farm profitability in the study area is presented below.

5.7.1 Age

The study results showed that age positively influenced the profitability of smallholder irrigators and was significant at a 5% level. As depicted by marginal analysis, a one-year increase in the age of household heads led to a 13.4% increase in profitability. The rationale is that older farmers may have access to more resources that could help them maximize their profits (Kebede et al., 2017). In contrast, Tashome *et al*. (2020) indicated that the household's age negatively affected farm profitability because the innovativeness and optimism of the entrepreneur, as well as his mental capacity to cope with the challenges of business activities and his mental and physical abilities to perform manual work decrease with age. Younger farmers easily understand and adopt the new technologies that improve farm operations, reduce production costs, and increase yields. Micheni *et al*. (2020) and Banda (2012) also indicated a negative relationship between age and profitability. Younger farmers are more likely to have access to or obtain a formal education. Therefore, they might successfully acquire agricultural information and understand new farming methods. As a result, the farm's profit will increase.

5.7.2 Farm size

The results indicate that farm size had a positive and significant effect on farmers' profitability at the 10% level. The implication of the results as depicted by the marginal analysis signifies that an increase in one hectare under production would increase profitability by 53.2% when other variables are held constant. Mersha *et al*. (2017) stated that as farm size increases, farmers cultivate more land and diversify, earning more agricultural output and improving profitability. The results concur with Mwatawala, *et al. (2019)*, Oband, (2012), Xaba and Masuku (2013), and Modeste et al. (2018), who found that the bigger the area of land put under production, the greater the economic returns. In contrast, Wongnaa (2016) and Wongnaa *et al*. (2019) reported that the size of the land under production had a negative influence on farm profitability. This implies that smallholder farmers with large farms cannot meet the input requirements of large farms because of a lack of credit. This results in low yields and low gross margins.

5.7.3 Access to credit

The study results show that access to credit had a statistically significant positive effect on farm profitability at a 1% level. A unit increase in credit access by producers led to a 43.1% increase in the profit margin. Credit allows farmers to invest in advanced farming technologies and ensures input and output marketing arrangements. The result of this study is consistent with the findings in the literature (Baiyegunhi, 2014, Manganhele, 2010 and Phakathi,2016). This result is also consistent with Sarfo (2018), Chisasa (2019), and Kanyua *et al*. (2015), who reported that access to credit services increases farm revenues and profit of smallholder farmers by alleviating the financial constraints in the acquisition of farm inputs. Mdoda and Obi (2019) stated that insufficient access to credit results in smallholder farmers relying on outdated technologies hence decreasing productivity and profitability at the farm level.

5.7.4 Packaging

The study results showed that packaging positively influenced the profitability of smallholder irrigators and was significant at a 5% level. The results show that household profitability increases by 23.4% as packaging production increases by one unit. This could be because packaging serves several functions, including protection, containment, and waste reduction. Therefore, applying appropriate packages minimizes post-harvest losses and improves profit. These results agree with Aliyi *et al*. (2019), who discovered that, as a farmer performs product, process, and functional upgrade activities, his productivity and quality improve, increasing his profitability.

5.7.5 Extension service

The study showed that extension service positively influenced the profitability of smallholder irrigators and was significant at a 1% level. The implication by the marginal analysis indicates that as access to extension services increases by a unit, profitability increases by 34.2%. This could be attributed to the fact that access to extension services influences farmers' profitability as farmers become equipped with crucial agricultural information such as grading and packing, which improve returns from the sales of produce. This result is in line with Terefe and Gemechu (2016), who affirmed that access to extension service equips farmers with crucial farming knowledge, particularly with increased production technologies. Majokweni (2018) stated that

farmers become exposed to risk and uncertainty if they do not access extension services and information about inputs, weather, market, and management practices.

5.7.6 Tractor hire

The study results show that tractor hiring positively influenced the profitability of smallholder irrigators and was significant at a 10% level. The result shows that for a unit increase in hiring a tractor for land preparation, there is a 24.6% increase in farm profitability. This result is expected because using a tractor enables farmers to cultivate a large plot of land and high cropping intensity. The finding of this study is in line with the study of Verma (2008), who found that mechanical power positively influenced the profitability of farmers. Houssou and Chapoto (2015) also found that mechanical power improves agricultural productivity and profitability through timeless operations and better quality of work.

Table 5.3: Factors affecting the profitability of smallholder irrigators

Dependent variables	**Regression coefficient**	**Std.Err.**	**P-value**	**Marginal effect**
Age	.0044593	.0019063	0.020**	0.134
Gender	-.0093983	.0504163	0.852	-0.260
Educational level	-.0235701	.0292716	0.422	-0.366
Land size	.05765	.070824	0.084*	0.532
Household size	.0050501	.0046988	0.284	0.247
Access to credit	.5268149	.0452775	0.000***	0.431
Hired labour	.0312921	.0423658	0.461	0.624
Market information	.0561358	.0441312	0.205	0.293
Extension service	.1872253	.0443432	0.000***	0.342
Packing	.0002892	.0000726	0.000***	0.234
Produce Exchange	-.023106	.0216187	0.286	-0.362
Farming experience	-.0006622	.0016605	0.286	0.481
Tractor hire	.0001366	.0000765	0.075*	0.246
_Cons	-.1732834	.1255013	0.169	

R-square= **0.6165**, Adjusted R-square = **0.5948**, F=**28.32**, Prob>= **0.000**

Note: ***, **, * represent significance level at 1%,5% and 10%, respectively.

5.8 Conclusion and recommendation

This study analysed gross margin and factors affecting smallholder irrigators in Tugela Ferry and Mooi River Irrigation Schemes. Despite numerous constraints hindering smallholder irrigators farmers remain profitable in the study area since results showed positive profitability/gross margin. The study further indicates that six variables out of thirteen influence smallholder producers' gross margins. Age, land size, access to credit, extension service, packing, and tractor hire statistically and positively influenced the profitability of smallholder irrigators. Lastly, educational level, gender, household size, market information and farming experience of the household were none significantly.

Smallholder farmers lack mechanization, and they depend on hiring tractors, which are scarce in their respective areas and are expensive. Therefore, the government needs to provide smallholder farmers with farm mechanization such as tractors, ploughs, and trails.

Creating rural farmer groups with younger farmers' participation is necessary. The older farmers can benefit from the younger farmers' innovative knowledge skills and physical assistance with manual labour. Younger farmers can also use the experience of older farmers during the production and marketing process.

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CHAPTER 6: CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Recap of the research objectives and methodology

In South Africa, smallholder farming plays an essential role in the lives of many rural households as they contribute towards food security and employment. The literature corroborates that many smallholder farmers in South Africa face several barriers preventing them from gaining access to the value chain. Smallholder farmers are often obliged to sell at low prices (immediately after harvest) and buy at high prices, with little information on when to conduct transactions as they are price takers. Most smallholder farmers are located in remote areas with poorly maintained roads and market infrastructure, storage facilities, and inadequate transport, which causes high transaction costs. Value chain participation is essential for smallholder farmers, as it results in coordination and efficient use of resources, goods, and services. It also allows farmers to derive benefits such as income and accessible opportunities for rural employment.

The study's main objective was to analyse smallholder irrigators' value chain participation and profitability in KwaZulu-Natal Province, South Africa. The study analysed three specific objectives. Firstly, it sought to identify actors involved in the value chain of smallholder irrigators. Secondly, the determinants of smallholder irrigators' participation in the value chain and level of participation were investigated. Thirdly, the study evaluated factors affecting smallholder irrigators' profitability to ascertain the contribution of value chain participation. Data was collected from 243 smallholder irrigators using a random sampling technique. Eighty-seven farmers were selected from MRIS, and 156 were from TFIS. In addition, data was analysed using descriptive and econometric techniques. Descriptive statistics made use of comparison of means and percentages, and econometric analysis involved the double hurdle model, gross margin, and multiple linear regression. This chapter presents the main conclusion of the study. The chapter also includes several policy recommendations based on the empirical results.

6.2 Summary and conclusion

Descriptive statistics, an econometric model and gross margin were used to analyse the primary data collected using (STATA and SPSS version 27 computer software). Out of 243 total

households' heads interviewed 77% were female and 23% were male. The findings indicated that 65% of sampled respondents were illiterate whereas 35% were literate. The smallest size of the farmers' land was 0.1 hectares and the largest size was two hectares. The results indicated that value chain actors had some relationships. The study identified seven actors involved in the smallholder irrigators value chain: input suppliers, producers, collectors/hawkers, wholesalers, retailers, consumers, and value chain supporters. Most of the farmers did not have reliable markets and faced very high competition from fellow farmers and every farmer was competing to sell produce before it deteriorated. None of the sampled farmers practised all the identified value chain activities.

Value chain activities primarily performed were cleaning and sorting. The findings revealed that, overall, several factors constrained the value chain activities of smallholder irrigators and hindered the development of the value chain. The production phase was constrained by several factors, e.g., high input costs, lack of certified seeds, lack of storage, and high credit rates. The significant constraints witnessed at the marketing phase were poor roads/ transport facilities, lack of sufficient market information and lack of storage facilities in the face of perishability. The majority of farmers were most preoccupied with the primary production phase of the value chain. Multivariate probit model results for smallholder irrigators demonstrated that from the variables hypothesized to influence farmers' choice of market outlets, education level, household size, transport reliability, and farming experience were some of the factors that significantly affected farmers' choice of alternative markets.

The double-hurdle model applied in this study was specifically intended to investigate factors influencing the agricultural value chain and intensity of participation. There were five (5) explanatory variables among the other affecting factors that were found to have a significant influence on value chain participation. Age was positively significant, meaning that more older people participated in the value chain. The rationale behind this is that older farmers have experience, expertise and connections. Access to credit was positive and significant. This can be explained by the fact that credits increase the volume to purchase improved seeds, ensuring farmers have access to assets so that they can meet market demands, expand operations and invest in value-adding. Extension service was positive and significant because extension assistance helps farmers become aware of improved technologies and adopt them to improve efficiency. Access to the road was positive and significant. The rationale behind this is that access to good roads prevents spoilage due to road accidents and the inability of vehicles to

reach farm locations due to bad roads. This minimizes transaction costs. Ownership of livestock was also positive and significant. This indicates that productive assets such as oxen used for direct production generate a marketable surplus. This encourages households to participate in the value chain. Age, livestock ownership, land size, labour, credit access, exchange of produce, and training in value-adding significantly influenced the level of value chain participation among smallholder irrigators.

The study found a positive gross margin among smallholder irrigators in the Tugela Ferry and Mooi River Irrigation scheme. Tomatoes had the highest gross margins in economic performance, while field beans had the least. However, tomatoes required high maintenance. Empirical model results found that age, land size, access to credit, extension service, packing cost and tractor hire positively influence profitability.

6.3 Recommendations

Based on the results of the study, the following recommendations were drawn:

6.3.1 Formation of active farmer groups

Local extension officers need to organise smallholder irrigators into farmer groups to speak with one voice when they are approaching the marketplace. Buyers easily exploit unorganized farmers whereas, organised farmers can negotiate and bargain better prices. Buyers can easily persuade unorganized to drop their prices as the buyers can approach different farmers before buying produce and the farmers end up being price takers. Farmers organized into groups can share production equipment and knowledge required in a value chain and increase marketable surplus. Therefore, it would be easy to meet formal market demand.

6.3.2 Training of agricultural extension officers' staff and farmers

Extension officers should be trained to improve their technical skills to educate farmers on value-added activities. The study found that extension officers tend to focus on training farmers in the production phase but neglect training in value-added activities and marketing. Farmers were not aware of the market requirements and value chain activities because they were not well trained. Therefore, the government needs to set up colleges where extension officers will be trained at least twice a year about strategies and modern technologies. This is because most smallholder farmers in South Africa only rely on government extension officers.

6.3.3 Farmers diversification

Smallholder farmers need to diversify from producing the same vegetables, such as tomatoes and cabbages, as they face stiff competition from other producers during harvesting. Markets end up being flooded by the same product, resulting in a drop in prices. As a result, cultivating products such as okra, watermelon, butternut, dragon fruit, rocket plant and coriander can make finding markets easier as these products are in high demand. These products can be marketed easily and boost farm profitability. They can stay longer without proper storage compared to products such as tomatoes.

6.3.4 Farmers training

Government and its stakeholders should intensify training to improve farmers 'skills. Training farmers through workshops, seminars, and farm plot demonstrations is vital for improving smallholder irrigators' productivity, leading to higher profit. Farmers need to be trained and taught value-adding activities.

6.3.5 Youth programs

Governments need to design programs that educate youth about agriculture and change youth perceptions of agriculture. The study found that only a few youths were involved in agriculture. Although Coronavirus outbreaks struck the agricultural sector, it proved to be a crucial sector. Agricultural had kept employment levels going even when most industries or sectors reduced employment. Therefore, this proves that agriculture is essential, and government needs to design programs to recruit youth to agriculture.

6.3.6 Mobile app technology

The world is turning digital. Therefore, mobile app technology should be introduced and integrated with extension programs to improve awareness of market information to access better markets. Digital devices can be used to circulate information and remove middlemen from the value chain. Farmers could communicate with wholesalers or retailers directly in urban markets. Smallholder irrigators could partner with transporters to deliver to wholesalers in cities and have the money paid using mobile transfer without the farmers going to the city.

6.3.7 Credit provision

The study found that the lack of access to credit constraints farmers to produce more marketable surplus. Therefore, broadening sources of agricultural credit institutes such as institutional service can play an essential role in improving the value chain participation and yield of smallholder irrigators. Access to credit will improve the ability of farmers to acquire quality agricultural inputs and improved techniques.

6.3.8 Securing markets prior to production

The majority of the smallholder irrigators in the study are engaged in agricultural production without market consultations. Therefore, this indicates that farmers start searching for the market when their produce is harvested. Consequently, farmers lose a large amount of produce due to spoilage due to the lack of storage. Therefore, securing the market before production could reduce produce loss and improve farm profitability. By using the SHEP model with the assistance of extension officers, markets can be secured before production can begin.

6.3.9 Information centre

There is a need to establish an information centre in the districts, which could help by providing valuable market information (pricing, quality of produce, etc.). The centre should also provide training to farmers (managerial skills, bookkeeping, etc.). Community radio stations also should be used extensively to ensure farmers within the region have better access to information.

6.3.10 Adult education

The effects of education and risk attitudes on technology adoption can be estimated by educated people, meaning that education encourages farmers to adopt innovations. Thus, education encourages innovation, a potentially risky undertaking. Therefore, the study recommends adult education.

In conclusion, the study has found that smallholder irrigators can improve rural livelihood and food security. Therefore, the recommendations suggested by this study need to be implemented to improve value chain participation and farming status in the study area.

6.4 Areas for further study

The study has identified areas of research that need attention for further study to improve agricultural productivity in rural areas. The current research could not reach all the actors or value chain supporters involved in a value chain of smallholder irrigators. Therefore, there is a need for a study to investigate each actor or chain supporter. It will be interesting to know what happens after the product of smallholder farmers reaches other actors. Do the bakkie traders add value to the produce, how much cost they incur, and how much they sell produce? Therefore, a larger sample should be used in the future.

Appendix 1: Questionnaire

An analysis of the value chain participation and profitability of smallholder irrigators in KwaZulu-Natal.

Demographic information

Head of household name & Cell Number	
Date	
Gender of head household	
Scheme Block	

1 What is head household age/ year of birth.....years

2 What is the highest educational level that you attained so far?

No formal education	Secondary education	Primary education	Tertiary education	Other (specify)

3 Total number of household members: ……?

4 Marital status of the household head

Single	Married	Divorced	Widowed

5 How many irrigation plots you own: .....? (Indicate)

6 How many irrigation plots do you use: …….? (Indicate)

7 How many irrigation plots you rent (in/out) ……. ?(Indicate)

Production and Input

8 Do you hire labour to work on the farm? (1) YES (2) NO

9 If YES indicate the number of employees who usually assist with farm work (Tick all appropriate)

Type of employee	**Number**
1 Full time employee	
2 Casual employees	
3 Other (specify)	

10 Do you always get inputs in the quantities that you need from retailers? (1) YES (2) NO

11 Do they always get delivered at the right time? (1) YES (2) NO

12 If NO what are the challenges

1 Too expensive	2 Far distance	3 Cash shortage	4 Other (specify)

13 What is the main reason for buying from the source you use/s? (Tick all appropriate)

1 Lower price
2 Higher quality
3 Home delivery
4 Near your home
5 Others (specify)

14 What livestock do you own?

Livestock type	**Number owned**		**Number owned**
Cattle		Sheep's	
Goats		Chickens	
Donkey		Other (specify)	

Marketing

15 Did you sell your produce? (1) YES (2) NO

16 If the answer for Q10 is No why didn't you sell your produce? (explain)

……
……
……

18 If the answer for Q11 is YES to whom did you sell? (Tick all appropriate)

1 Neighbours	2 Informal traders	3 Small shops	4 local schools	5 Big supermarkets	6 Other (specify)

19 For how long have you been selling your produce (years)? ----------

20 What are the reasons that made you to decide to sell in your preferred markets (Tick all appropriate)

1 Distance	2 Transport availability	3 Price	4Contracts	5 Other (Specify)

21 Do you go into agreement with your buyers? (1) YES (2) NO

22 If yes, explain the nature of the agreement

……
……
……

23 If you are selling your produce in the markets what are/were the requirements to you?

Transportation and infrastructure

24 How do you transport your produce to the marketing points? (Tick all appropriate)

1 Hire bike
2 Public transport
3 Buyers come
4 Own transport
5 Other (specify)

25 How much does it cost to take your produce to the market?

26 Is the transport reliable? (1) Yes (2) NO

27 Explain

……
……
……

28 Is the road good for marketing system? (1) YES (2) NO

29 If the answer is NO explain

……
……
……

30 How much did you sell, each year, for the past 3 years (kg)?

Agricultural produce	2018/2019	2019/2020
Potatoes		
Tomatoes		
Beans		
Cabbage		
Garlic		
Maize		
Spinach		
Onions		
Other (specify)		

Market information

31 Before supplying your produce to the market do you get any markets information (e.g., where to sell, market price)? (1) YES (2) NO

32 If the answer is YES for Q25 where you get market information? (Tick all appropriate)

Friends/ Neighbours
Extension officers
Go to market in town and see
Television programme if yes which programme
Radio programme if yes which programme
Traders
Other (specify)

33 What marketing constrains do you face? (Tick all appropriate)

1 No/less market information	2 Low price/ Price instability	3 No buyer/ Lack market	4 Low/ No bargaining power	5 Transportation	6 Others (specify)

Prices

34 Do clients buy all your produce?

35 If Yes who determine the price of your produce?

36 Are there any challenges you experience when satisfying buyer requirements? (1) YES (2) NO

37 If you are not satisfied with the prices that is offered by the buyer, what alternatives do you have?

Credit

38 Have you obtained credit since you started farming? (1) YES (2) NO

39 If do not have access to credit, why? (Tick all appropriate)

1 I do not have title deed of my land or collateral that they want
2 I do not have a credit records at credit providers
3 Other (specify)

40 If YES what is your source of the credit? (Tick all appropriate)

1 Commercial banks	2 Informal lenders/Mashonisa	3 Non-Governmental Organisation	4 Micro-finance institutions	5 Friends or Family	6 Other (Specify)

41 How much you received and their interest rates?

42 Did you manage to repay the loan?

43 What are or were the conditions required to access the credit?

44 When you received credit, what were used for? (Tick all appropriate)

1 Purchase agricultural inputs
2 Hire farm Labour
3 Purchase agricultural machinery
4 Other (Specify)

Storage and Processing

45 Do you have storage that belongs to you? (1) YES (2) NO

46 If answer is No where you store you produce after harvesting?

47 If YES what is the average capacity of your storage?

48 Are there any problems about your storage?

49 Do you experience spoilage of your produce before it gets to your buyer?

50 If Yes what is the estimate of loss incurred in Kg……. Bags? (indicate)

51 Are there any activities you perform before selling your produce (Value addition)? (1) YES (2) NO

52 If yes what is the main motive

……
……
……
……
……

53 Could you mention the activities you do as a value addition before you sell it

1 Cleaning	2 Cutting	3 Packaging	4 Sorting	5 Curing	4 Other (specify)

54 Have you ever received training regarding to upgrading your produce? (value adding) (1) YES (2) NO?

55 What constraints do you face during upgrading (value addition)?

56 Do you sometimes exchange produce for other commodities? 0=N0 1= YES

Competition

57 Who are your major competitors?

58 Where are they located?

59 How are you differ from your competitor?

THANK YOU FOR YOUR COOPERATION!!!