Information Asymmetry and Profitability of Tomato and Butternut Value Chains: A case of Nwanedi Agri-hub

By

LIVHEBE NKHUMELENI PATRICK

Student No.19017665

A dissertation submitted in fulfilment of Master in Rural Development Degree (AGMARD) in the Institute for Rural Development

Faculty of Science, Engineering and Agriculture

University of Venda

SOUTH AFRICA

Supervisor : **Prof M. Manjoro**

Co-Supervisor : **Prof J. Zuwarimwe**

April 2025

ABSTRACT

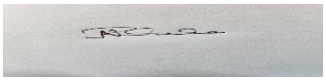
The agricultural economic subsector plays a crucial role, in food and nutrition security, trade balance, employment creation, and the supply of raw materials to agro-industries, however, the participation of smallholder farmers in the agricultural production chain and their contributions to value addition, remain poorly understood. Additionally, there are concerns regarding information asymmetry along the value chain, which may disadvantage smallholder farmers. This study aimed to address these gaps by mapping and characterizing the value chains for tomato and butternut crops and comparing the value creation and information sharing processes for these crops. In this study, a quantitative research design was employed and primary data was collected from various stakeholders along the value chains using closed-ended questionnaires. A sample of 150 smallholder farmers from 10 clusters was randomly selected. Data analysis included descriptive statistics, value chain mapping, and inferential statistics such as profitability ratios and Return on Investment (ROI), using the Statistical Package for Social Science (SPSS) version 26 and Excel.

The analysis of the tomato and butternut value chains in Nwanedi showed a varied group of participants, such as agro-dealers, farmers, processors, distributors, and retailers, backed by the Nwanedi Agri-hub. In spite of the assistance provided, small-scale farmers encounter challenges, such as significant information gaps. Farmers are often unable to access up-to date market prices and demand trends, which weakens their bargaining position in centralized markets and enables intermediaries to make excessive profits, ultimately reducing farmers' profits. The statistical data showed notable differences in profitability for tomato and butternut growers, which are affected by sales methods and how the crops are managed. Butternut farmers who sell their produce directly to merchants experience increased profitability and earn an average ROI of 15%, in contrast to those who depend on intermediaries. Profits for tomato growers are significantly affected by input expenses and the ability to utilize effective market routes, with only advanced crop-management resulting in profitable returns. It is important to mention that ROI can differ among tomato farmers, with some reaching a 20% ROI from direct sales, while others face low returns because of expensive inputs and limited market opportunities. The study concludes that addressing information asymmetry through improved market linkages and providing smallholder farmers with timely market information is critical for enhancing their resilience and profitability. Strategic measures, such as farmer cooperatives, infrastructure investments, and price stabilization mechanisms are recommended to help increase farmers' share of the retail price and ensure long-term agricultural sustainability. Tailored support and interventions, hence, are essential for improving the productivity and livelihoods of smallholder farmers in the Nwanedi region.

Keywords: Crops, Information Asymmetry, Profitability, Smallholder Farmers, Value Chain

DECLARATION

I, Livhebe Nkhumeleni Patrick, hereby declare that this dissertation for the Master of Rural Development, submitted to the University of Venda, has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all reference materials contained therein have been duly acknowledged.

Signature  Date 21 April 2025

DEDICATION

To my colleagues in the Limpopo Department of Agriculture and Rural Development and all smallholder farmers in the Nwanedi valley, South Africa and the African continent, at large.

ACKNOWLEDGEMENT

Life is too short to learn only from one's own experience, it was refreshing and encouraging to learn from experiences of a great team of the Institute of Rural Development at the University of Venda, led by Professor Joseph Francis - what a family you are!

I would like to express my sincere appreciation and gratitude for guidance, support and motivation by Professor Marizvikuru Mwale-Manjoro and Professor Jethro Zuwarimwe, my supervisors. At my lowest point, almost at the point of giving up, they would always find a way to motivate me to soldier on. Without your motivation and contribution, this study would not have been possible. Thank you for believing in me.

All my colleagues in the Limpopo Department of Agriculture and Rural Development who assisted in data collection and motivation are highly acknowledged. Your valuable inputs are greatly appreciated.

I owe a special gratitude to my family, my wife Phumudzo Prudance and son Onkwama, daughters Uhone and Mimi Livhebe for motivating me; you were very understanding when I had to stay up all night and you afforded me study time without complaining. I thank God for blessing me with such a wonderful family. Thank you for praying for me. I thank God Almighty for granting me grace to complete this study, for I know and believe that without God, we cannot achieve anything.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ANNEXURES

ABBREVIATIONS

AOI	Agriculture Orientation Index
APMBP	Agri-Park Master Business Plan
CPA	Communal Property Associations
DAFF	Department of Agriculture Forestry and Fisheries
DRDLR	Department of Rural Development and Land Reform
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
ISS	Institute for Security Studies
LDARD	Limpopo Department of Agriculture and Rural Development
NDP	National Development Plan
NMDIP	Nwanedi Master Development Infrastructure Plan
SDG	Sustainable Development Goals
SPSS	Statistics Package for Social Sciences
StatsSA	Statistics South Africa
VAA	Value Added of Agriculture

CHAPTER 1
INTRODUCTION

1.1. Background

The agricultural sector remains a significant cornerstone for a nation's various socio-economic aspects including food and nutrition security, trade equilibrium, employment generation, and provision of raw materials to agro-industries (Department of Agriculture Forestry and Fisheries (DAFF), 2012). The Department of Agriculture Land Reform and Rural Development (DALRRD) (2022) estimated that the collective contribution of the agriculture, forestry, and fisheries sectors to the Gross Domestic Product (GDP) in 2020 amounted to 2.7%. Sustained enhancements in the productivity of crops and livestock are essential for economic growth in agriculture and promote environmental health. Practices such as precision agriculture, integrated pest management, crop rotation, agroforestry, organic farming, and sustainable livestock management exemplify effective approaches to boost yields sustainably. These methods improve resource efficiency, soil health, and biodiversity while reducing reliance on chemicals. By implementing these techniques, farmers can ensure long-term productivity and profitability while supporting a healthier ecosystem. There are persistent concerns, however, around adverse effects stemming from information asymmetry, climate variability, and the profitability of smallholder farming, particularly within the global and South African contexts, given the latter's pronounced water stress. According to Mabhaudhi *et al*. (2018) and Scholes & Engelbrecht (2021), projections suggest a forthcoming increase in aridity across Southern Africa, posing challenges for already impoverished smallholder farmers with limited adaptive capacity. The dearth of accessible information exacerbates the complexities of running agribusinesses and integrating them into value chains, within this region (Scholes & Engelbrecht, 2021).

Smallholder farmers who do not have access to vital market data and agricultural methods are frequently at a disadvantage when there is information asymmetry, which happens when one side to a transaction has more or better information than the other (Scholes & Engelbrecht, 2021). According to Institute for Security Studies (ISS) (2018), because farmers may find it difficult to make well-informed decisions about pricing, production, and market entry, this lack of knowledge can reduce profitability and ultimately impact their capacity to compete in value chains. Furthermore, without the right information, smallholders might not be able to successfully join the current agricultural value chains, which could result in lost chances for cooperation and expansion (DALRRD, 2022). Improving profitability and ensuring smallholder farmers can prosper in an increasingly difficult agricultural environment require addressing these discrepancies. These challenges are anticipated to escalate due to climate change, which forecasts a surge in extreme

rainfall events, further encumbering agricultural production and it will be particularly pronounced in the semi-arid northeastern regions of South Africa, namely Limpopo and Mpumalanga Provinces, where agriculture serves as the principal economic pillar (Scholes & Engelbrecht, 2021). Agriculture in South Africa currently consumes approximately 63% of the nation's water allocation and withdraws 62.52% of all freshwater resources (ISS, 2018), necessitating a comprehensive water management strategy to address escalating demands precipitated by population growth and economic expansion. Aligned with Sustainable Development Goal 2, which underscores the imperative of - eradicating hunger, achieving food security, enhancing nutrition, and promoting sustainable agriculture - smallholder farmers play a pivotal role in fostering inclusive growth and food security (Frederick, 2018). This strategic imperative is enshrined in the South Africa's National Development Plan (NDP) 2030, where smallholder agriculture is positioned as a linchpin for enhancing food security. Notably, the total agricultural production volume in 2021 surged to

R346,035 million compared to R310,179 million in 2020, representing a 11.6% increase (DALRD, 2022). This growth was chiefly driven by enhanced values of field crops (23.9%), horticulture (8.0%), and animal products (7.2%). Furthermore, the total contribution of agriculture to the GDP stood at R132 billion in 2021 and R133.84 billion in 2022 (DALRRD, 2022), underscoring the sector's economic significance. Against this backdrop, the South African government is channelling resources into smallholder agriculture as a core component in its inclusive growth strategy.

Smallholder farming has, additionally, emerged as a pivotal mechanism for fostering rural development and employment generation, in semi-urban and rural areas. South Africa's National Development Plan (2030) has underscored the agricultural sub-sector as central for enhancing the livelihoods of rural households. This prioritization is exemplified by the heightened governmental focus, manifested in the augmented budgetary allocation, which surged from R16.8 million in 2021 to R17.3 billion in 2022 (DALRRD, 2022). The landscape of South African agriculture exhibits a dualistic nature, with a pronounced association with capitalized commercial farming sub-sector, comprising approximately 35,000 farmers who account for 95% of agricultural output, predominantly on 87% of prime agricultural land (Pienaar & Traub, 2015; Zantsi, 2021). In contrast, the smallholder farming sub-sector, encompassing 4 million farmers, is typified by small-scale operations, labour-intensive practices, limited capitalization, institutional deficiencies, subsistence-oriented production, and predominantly female-controlled, contributing less than 5% of the agricultural value on 13% of the land (Pienaar & Traub, 2015; Sihlobo & Qobo, 2021).

To bolster the capacity of smallholder farmers, the government initiated the Agri-Park Development strategy in 2014, as a pivotal component for agricultural transformation and inclusive growth (Hanks, 2018) with the primary objective being to enhance the market integration of smallholder farmers. Among the beneficiaries of this scheme are the Nwanedi smallholder irrigation farmers,

who, akin to many others in the category, confront extensive challenges related to production inefficiencies, limited market participation, and consequently, restricted contributions to the formal economy (Dhillon & Moncur, 2023). The Nwanedi AgriPark Development represents an initiative benefiting 214 smallholder farmers, operating on an average of six hectares of land leased from Nwanedi and Mandiwana Communal Property Associations (CPA) and under the jurisdiction of traditional authorities. These farmers are geographically grouped into ten clusters, each comprising fifteen farmers. They are integrated into existing niche markets to leverage economies of scale through collective purchasing and shared services, along with coordinated market supply. The overarching aim of the initiative is to establish a franchise-like supply chain to attain various objectives. Primarily, it seeks - to enhance smallholder farmers' access to agricultural inputs; improve access to suitable financial support; enhance infrastructure; streamline production processes to reduce costs; enhance produce quality and marketability as well as augment market access on favourable terms. Additionally, the initiative encompasses provisions for business training, support services, and mentoring or coaching endeavours for the participating farmers (Feukeng, *et al*., 2023).

The Nwanedi Agri-hub is set up as a cooperative platform that links farmers, nearby companies, and agricultural specialists in order to improve market accessibility and production. Farmers have an important role in the hub's decision-making process and get access to resources like better supply chains, technology, and training. In order to improve their farming methods and general profitability, the centre also provides financial assistance and networking opportunities. Nwanedi farmers are poised to capitalize on the opportunities arising from globalization and the expanding national and international markets, as well as the burgeoning middle- and high-income classes in numerous developing countries (Frederick, 2018). The underlying assumption is that, with adequate built capacity, smallholder farmers can exert greater control over the production, trade, and distribution of their agricultural output; this, in turn, is expected to yield high-quality and marketable produce. Particularly within the vegetable market, enhancing profitability emerges as a crucial focus for smallholder farmers. Consequently, improving the effectiveness and competence of these farmers necessitates ensuring the quality of their products while concurrently fostering cost-effective production methods, hence, access to relevant information, along the horticultural value chains, and the evaluation of smallholder farmer profitability in Nwanedi, become imperative.

Tomato (*Solanum lycopersicum*) stands out as one of the prominently cultivated and consumed vegetable crops in South Africa (Kwikiiriza, 2022). Limpopo Province emerges as the principal tomato producer, with the crop cultivated on over 3500 hectares of land, across all five districts by both smallholder and commercial farmers (Kwikiiriza, 2022). Remarkably, the Province contributes 75% of the total tomato cultivation area in South Africa, with the Mopani and Vhembe regions

serving as the primary production hubs (Dhillon & Moncur, 2023). The widespread popularity of tomatoes among South African consumers, attributed to its nutritional value, robust demand and market availability, underscores its significance for research endeavours. Additionally, a significant proportion of tomato farmers integrate the cultivation of the butternut crop (*Cucurbita moschata*) into their agricultural practices. Butternut holds preference among smallholder farmers due to its adaptability to diverse soil and agro-climatic conditions, its nutritional profile, and extended shelf life, rendering it a preferred choice among middle-income earners. Moreover, the lower production costs associated with butternut cultivation further accentuate its appeal to farmers (Kwikiiriza, 2022).

1.2. Research Problem

Rural communities surviving from agriculture initiatives in South Africa continue to grapple with persistent challenges such as high unemployment rates, particularly among women and youth, entrenched inequality, and pervasive poverty (Mabhaudhi, 2018). In response to these pressing issues, the South African Government has consistently directed investments towards agricultural initiatives, focusing on infrastructure development, as well as, production and input support. The overarching goal is to enhance the involvement of smallholder farmers in mainstream agricultural value chains, however, despite these efforts, smallholder farmers still face significant barriers to participating effectively in the agricultural value chain. Maponya *et al*. (2016) and Sihlobo & Qobo (2021) have highlighted various constraints hindering the integration of smallholder farmers into the agricultural value chain. These include - stringent supply requirements imposed by large retailers (such as quality, consistency, and reliability); insecure property rights; the modest scale of operations of smallholder farmers resulting in unreliable supply of produce; inadequate infrastructure; limited access to credit; scarcity of market information, and considerable distances to markets.

Aligned with Sustainable Development Goals 2, as well as the Zero Hunger Challenge, the government has allocated 150 million to empower smallholder farmers in Nwanedi, through initiatives like the Agri Park (Dhillon & Moncur, 2023). Nevertheless, concerns persist for despite these substantial investments, smallholder farmers in Nwanedi Agri Park are not fully reaping the financial benefits commensurate with the value they generate. Their participation across the entire agricultural value chain appears constrained, possibly due to information asymmetry. The prolonged cultivation of the same crop mix and reliance on the same input suppliers over the past two decades may signal limited access to pertinent information along the value chain by farmers (Rex *et al.,* 2015). Research elsewhere suggests that well-functioning value chains, facilitated by farmers possessing comprehensive information about activities at each segment, foster

sustainability in farming enterprises by ensuring equitable distribution of value created among stakeholders (Hanks, 2018; Agyekumhene *et al*., 2020). The assumption that newly-introduced farmers will seamlessly integrate into existing value chains may not align with the interests and objectives of these new entrants, given that current value chains were predominantly designed to cater for the needs of commercial farmers. Against this backdrop, this study aims to scrutinize the value chains and profitability of tomato and butternut crops in Nwanedi and explore the ramifications of information asymmetry on their profitability.

1.3. Justification/rationale of the study

The findings of this study hold significant implications for the government and its stakeholders, by providing valuable evidence to inform policy formulation aimed at supporting smallholder farmers and ensuring the success of Agri-Parks. By shedding light on the challenges stemming from information asymmetry within horticultural value chains, findings can guide the development of strategies to expedite the transition of smallholder farmers into the commercial farming sub-sector, thereby facilitating the much-needed transformation of the agricultural sector. Moreover, farmers themselves, directly stand to benefit from the research findings, as they will gain insights into optimal models for enhancing horticultural value chains and improving profits within their enterprises. Equipped with this knowledge, it is anticipated that farmers can make more informed decisions, thereby bolstering their capacity to create employment opportunities, vital for local economies. Furthermore, the research will contribute to the broader body of knowledge, enriching the understanding of how asymmetric information impacts horticultural value chains, particularly within the smallholder sub-sector. Fellow researchers would benefit from the study's insights, as they can provide a deeper understanding of the dynamics at play within agricultural value chains and inform future research endeavours. Crucially, the study fills a notable gap by assessing whether investments in Nwanedi have effectively facilitated the enhanced participation of farmers in value chains. By generating such pertinent information, the study addresses a critical aspect of agricultural development, paving the way for more targeted interventions and improved outcomes for smallholder farmers.

1.4. Objectives

The main objective of the study was to assess the impact of information asymmetry on the profitability of value chains of selected horticultural crops in the Nwanedi Agri-hub program. The specific objectives were:

i. To characterize the value chains for tomato and butternut crops at Nwanedi Agri- hub;
ii. To compare the value creation and information sharing process of butternut and tomato crops in Nwanedi Agriculture Park; and

iii. To compare the profitability of tomato and butternut production at farm gate in Nwanedi Agri-hub.

1.5. Research questions

i. What are the characteristics of the tomato and butternut crops' value chains for smallholder producers in Nwanedi Agri-hub?
ii. How are value creation and information-sharing processes for tomatoes and butternuts compare at the Agri-hub?
iii. How profitable is butternut and tomato crops at farm gate for the smallholder farmers in Nwanedi Agri-hub?

1.6. Theoretical framework of the study

The information asymmetry theory, highlighting the disparities in the dissemination of vital information within the agricultural value chains, as elucidated by Schrobback *et al*. (2023), lies at the core of this study. The theory posits that actors possessing greater and more pertinent information are better equipped to make informed decisions regarding a phenomenon, in this case, transactions about inputs and outputs within the value chain (Frederick, 2018; Ullah *et al*., 2020). Any unequal distribution of information may result in the preferential selection of more knowledgeable and bigger and productive farmers, potentially leaving others feeling marginalized, particularly in markets such as those for tomatoes or butternuts, where access to market information is critical. It is widely acknowledged that farmers often function as price takers, with market prices determined by the interplay of supply and demand dynamics (Rex *et al*., 2015), however, due to factors, such as limited education, age, and low economic status, smallholder farmers may lack a comprehensive understanding of the determinants of market prices, leading to a sense of being inadequately informed. This perception can contribute to moral concerns, where smallholder farmers may fail to adhere to market or credit agreements. Consequently, this situation may culminate in market failures for smallholder farmers, underscoring the opacity and inefficacy of value chains in catering to their needs. To enable smallholder farmers to make rational decisions that positively influence the profitability of value chains, it is imperative, hence, to address the prevailing information gap (Frederick, 2018; Casali *et al*., 2020). By bridging this divide and ensuring equitable access to relevant information, interventions can then even empower smallholder farmers to navigate markets more effectively, thereby enhancing the overall functionality and inclusivity of agricultural value chains.

1.7. Operational definitions of key terms and concepts

Information asymmetry – Deals with the study of decisions in transactions where one party has more or better information than the other, hence, creating an imbalance of power in transactions. In the worst-case scenario, information asymmetry creates market failure, that is, adverse selection, moral hazard, and monopoly of power (Schrobback *et al*., 2023).

Horticulture – refers to vegetable production, such as tomatoes, beans, and butternut, mainly for selling (Rather *et al*., 2023).

Value chain – A concept that traces product flows, shows value additions at different stages and identifies key actors and their relationships in the chain (Anastasiadis *et al*., 2020).

Profitability *of the value chain* – Profitability is the comparison of what is done with what can be achieved with the same resources (for instance, money, time, labor). An efficient value chain is one in which production flow, there are value additions at different production stages; key actors are all active and all actors work harmoniously, with little to no market failure (Rex *et al.,* 2015).

Nwanedi Agri-hub program – An enterprise-development initiative in Limpopo whose aim is to empower smallholder farmers to operate in a more coordinated, business-oriented manner. For this program, the farmers were supported with hard infrastructure (irrigation equipment, packhouse, machinery, and other movable assets) and soft infrastructure which include agricultural, technical and business support (LDARDR, 2014).

1.8. Study limitation

Due to time and budgetary constraints, the geographical scope of the study was limited to Musina Local Municipality, with a specific focus on Nwanedi Valley and farmers participating in the Nwanedi Agri-hub development project.

1.9. Outline of the Dissertation

This dissertation is composed of seven chapters. Chapter 1 consists of the research background, which sets the scene for the whole study; included in this chapter are the research objectives, problem statement, and justification of the study. In Chapter 2 is a literature review of previous and related studies; the literature explicates global and local perspectives on value chains. Chapter 3 covers the research methodology, which includes discussions on data collection and analysis techniques, as well as ethical considerations adhered to in the study. Chapters 4 – 6 presents the results of the study, which covers the findings and discussions. Chapter 7 provides a conclusion to the whole study as well as making recommendations on handling of information asymmetry and

profitability of tomato and butternut value chains. Scholars whose information was used in compiling this dissertation were duly acknowledged through citations in text, as well a list of references. At the end of the dissertation, appendices showing the ethical clearance certificate and data collection tool(s) are presented.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter provides a comprehensive review of literature about information asymmetry and profitability within the value chains of selected horticultural crops, with reference to tomatoes and butternuts. The concept of value chains, encompassing the processes and activities through which organizations or companies add value to products, production processes, marketing, and the provision of after-sales services, has garnered significant attention from governments, in developing countries (Frederick, 2018; Anastasiadis *et al*., 2020). In the light of this, the literature reviewed in this section spans a global and regional perspectives, focusing on the challenges and dynamics surrounding information asymmetry and value chains for smallholder farmers. By examining existing research, this chapter seeks to elucidate the complexities inherent in information dissemination within agricultural value chains, particularly for smallholder farmers. The review encompasses insights into the various factors contributing to information asymmetry, including - disparities in access to market information, limited education and awareness among farmers, as well as structural constraints within the value chains. Additionally, the literature delves into the implications of information asymmetry on the profitability and inclusivity of value chains, highlighting its ramifications for smallholder farmers' decision-making processes, market participation, and overall economic outcomes.

Furthermore, this chapter critically evaluates the interventions and strategies proposed to mitigate information asymmetry, within small-scale farming value chains, ranging from technological solutions and capacity-building initiatives to policy interventions and market reforms. Profitability of small-scale farmers is central to this study, therefore, by synthesizing diverse perspectives from global and regional contexts, this review aims to inform the design and implementation of targeted interventions aimed at enhancing the profitability and equity of value chains for smallholder farmers, with a specific focus on tomatoes and butternuts. Through a thorough examination of the existing literature, this chapter lays the groundwork for the empirical analysis and insights presented in subsequent sections of the study.

2.2. Agricultural Value Chain Perceptive

The concept of the value chain in agriculture encompasses various actors and activities aimed at adding value to agricultural products, from production to the end-user (Jacques, 2019; Anastasiadis

et al., 2020). There is a general consensus, as also articulated by Conceicao *et al*. (2016), that reducing global poverty and hunger necessitates, specifically, accelerating growth in the agriculture sector, increasing agricultural production, and enhancing the incomes of both men and women in rural areas, who rely on agriculture for their livelihoods. Investments in inclusive agriculture-led growth entail improving agricultural productivity and the quality of goods and services provided within this sector. As noted by Tanumihardjo *et al*. (2019), expanding markets and trade involves enhancing the competitiveness of smallholder farming and improving the value and quality of agricultural products. Consequently, elevating the value of agricultural produce, particularly in economically vulnerable rural communities, holds the potential to uplift large populations out of underdevelopment, food insecurity, and poverty.

Globally, approximately 1.5 billion people are engaged in smallholder agriculture, which serves as a vital source of food and income for rural households (Food and Agriculture Organization (FAO), 2018). Similarly, 75 percent of the world's poor population resides in rural areas, relying on agriculture as a primary source of food, income, and livelihoods (FAO, 2018). In line with this narrative, smallholder farming emerges as an effective tool for enhancing rural livelihoods. Regions such as sub-Saharan Africa, with a population exceeding 1.05 billion people, could significantly benefit from strengthening agricultural value chains to address the socio-economic challenges faced by farmers and rural communities (Kumar & Sharma, 2016; Sakho-Jimbira, 2020).

In Asian countries, challenges, such as the decline in the agricultural sector, persist despite its accepted significant contribution to gross domestic product. One reason for this decline is attributed to the reduced value of agricultural produce, resulting in heavy reliance on imported products (Booth, 2018; Anastasiadis *et al*., 2020). This is despite the increasingly recognition that agricultural growth in low-income countries, is three times more effective in reducing extreme poverty, compared to growth in other sectors (FAO, 2018). This underscores the pivotal role of agriculture in developing countries and the urgency of improving the value of agricultural produce to enhance food security and rural livelihoods.

The Agriculture Orientation Index (AOI), which measures the share of public expenditure on agriculture relative to the contribution of total GDP, highlights disparities in investment across countries. The AOI increased from 0.49 in 2002 to 0.54 in 2017 globally, despite this, significant reductions were observed between 2006 and 2015, with figures dropping to 0.31 and 0.46, respectively (FAO, 2016). Few countries reported an average AOI larger than one between 2013 and 2017, indicating that in most cases, the share of assistance devoted to agriculture is smaller than the contribution of the sector to GDP. Countries such as Botswana, Seychelles, Zambia, Eswatini, and Djibouti, however demonstrated an average AOI greater than one during this same period. AOI remains high in Western Asia and Northern Africa, but low in sub-Saharan Africa, where

the majority of the poor populace resides in rural areas characterized by low production profitability and value addition.

Reports suggest that millions of disadvantaged families and women, actively participate in smallholder farming as producers, traders, small-scale processors, and retailers (FAO, 2018). Moreover, a significant portion of the population in developing countries engages in agricultural value chains as labourers, consumers, and sellers in regional supermarket chains with many smallholder farmers directly selling their produce in local corner markets. Enhancing the value of smallholder farmers' produce holds the potential to catalyze rapid institutional and organizational change, including extensive consolidation of ownership and modernization of procurement processes, facilitated by integrated agricultural supply chains and contract farming models (Losch, 2020). Consequently, different continents, such as Asia and Africa, exhibit distinct agricultural characteristics and nuances in their agricultural value chains. These variations justify the need for context-specific approaches and interventions, tailored to the unique challenges and opportunities present in each region.

2.2.1. Agriculture Value Chain in India

Asia, encompassing both developed and developing countries, features agriculture as one of the leading sectors in rural areas. India, a prominent Asian nation, heavily relies on agriculture, which contributes approximately 18% to the total GDP (Bais & Bahadur, 2023). The sector employs up to 60% of the total population, benefiting from India's diverse and favourable agroclimatic conditions for various crops (Losch, 2020). The majority of farmers in India are smallholders, with around 85% owning an average of two hectares of farmland (Bisht *et al*., 2020), demonstrating the pivotal role of agriculture in rural India. Small-scale farmers in India, however, face numerous challenges, including - weather variability, limited access to technology and capital, inadequate services, low market integration, and lack of connectivity (Shekhar *et al*., 2014; Bisht *et al*., 2020). Indian farmers' lack of reliable and timely market information constrains their meaningful participation in agricultural value chains (Greenberg, 2019; Piabuo *et al*., 2020), thereby impeding their performance. Figure 2.1 show that contribution of Agriculture to GDP shows fluctuations over the years, starting just under 9.5% in 2002, peaking in 2004, and then generally declining or stabilizing around 8% from 2010 onwards. As for AOI of disbursement demonstrates variations during the period, with a noticeable drop from 2003 to 2004, then a rise peaking around 2009. After a dip, it shows an increase again from 2015 onwards.

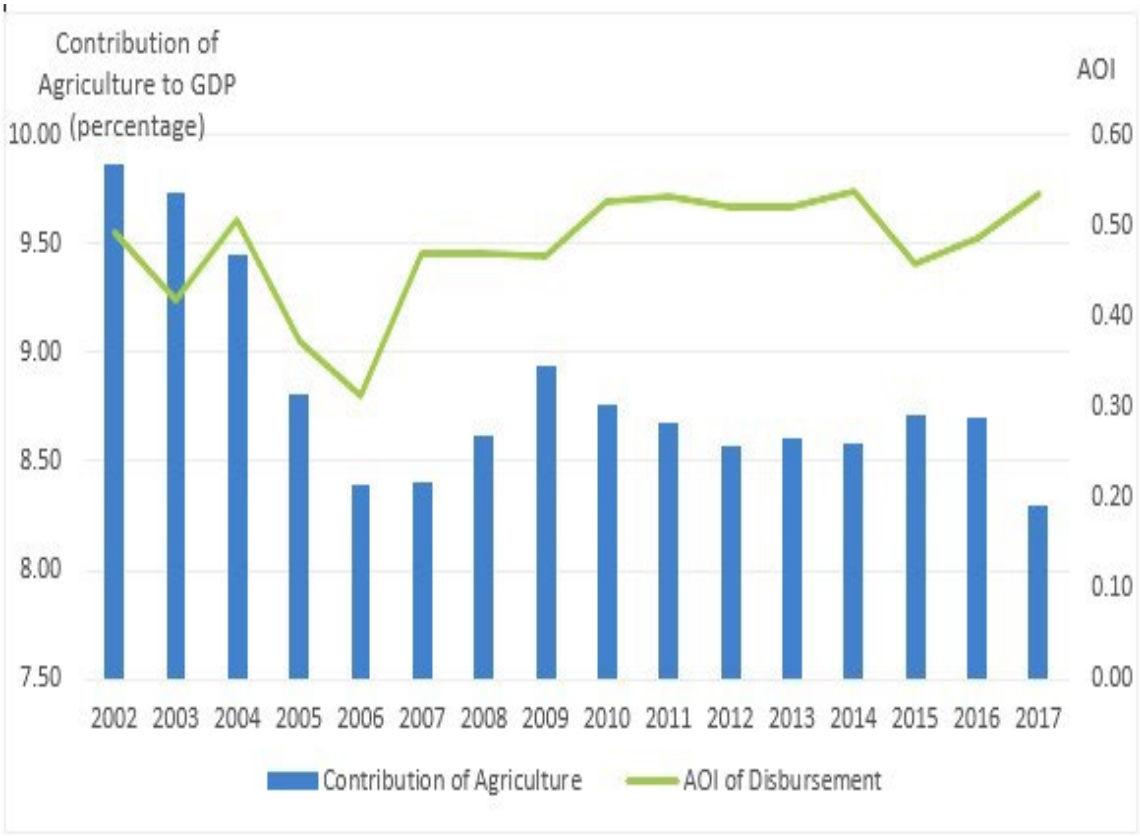


Figure 2.1: Global Agriculture Orientation Index (AOI): Source FAO, 2016

Indian smallholder farmers encounter constraints in accessing markets due to information asymmetry, despite their substantial contribution to food production (Fan and Rue, 2020). Local markets are often scarce, with selling points predominantly situated in urban areas, leading to high transportation costs, inefficiencies in marketing channels, and inadequate marketing infrastructure, which in turn, lead to fluctuating consumer prices in developing countries (Frederick, 2018; Fan and Rue, 2020). Particularly in fruit and vegetable marketing, smallholder farmers heavily rely on middlemen, who tend to garner a larger share of the profits due to the farmers' limited access to market information. Consequently, smallholder farmers and consumers receive a suboptimal deal, while middlemen wield significant control over the market. Similarly, the agricultural value chain in India, is often perceived as inefficient or broken (Somashekhar *et al*., 2014; Fan and Rue, 2020). Figure 2.2 illustrates a typical value chain model in India, specifically in the context of fruits and vegetables, elucidating how value chains are implemented in this sector.

Figure 2.2 illustrates the various channels utilized in the fruit and vegetable value chain in India, illustrating the involvement of different players, including the government, farmers, traders/retailers, agro-processors, and end-users. Notably, the government is primarily linked to farmers and food processors, indicating a lack of direct interaction between the government and other stakeholders such as retailers and end-users/consumers. This disconnect suggests a potential loss of information throughout the chain, and given the government's intermediary role in the market, information asymmetry may adversely affect production profitability of the whole fruit and vegetable value chain. As the primary producers, farmers require comprehensive information from various stakeholders to tailor their production to meet the needs of other players and set appropriate prices. Across different continents, including Asia, Africa, Australia, and South America, fruits are among the leading agricultural products exported globally (FAO, 2018). In Africa, countries such as Egypt, Sudan, Kenya, Uganda, and South Africa stand out as major exporters of vegetables (Hanks, 2018). Notable vegetable exports from West and Central Africa include - amaranth (Sudan), bambara beans (Kenya), celosia (Egypt), and cowpeas (Uganda) (Frederick, 2018). Similarly, in Southern Africa, South Africa is renowned for exporting baby vegetables, fruits, and various crops, exhibiting similarities with other exporting countries, such as India (FAO, 2016; Mahlangu *et al*., 2020).

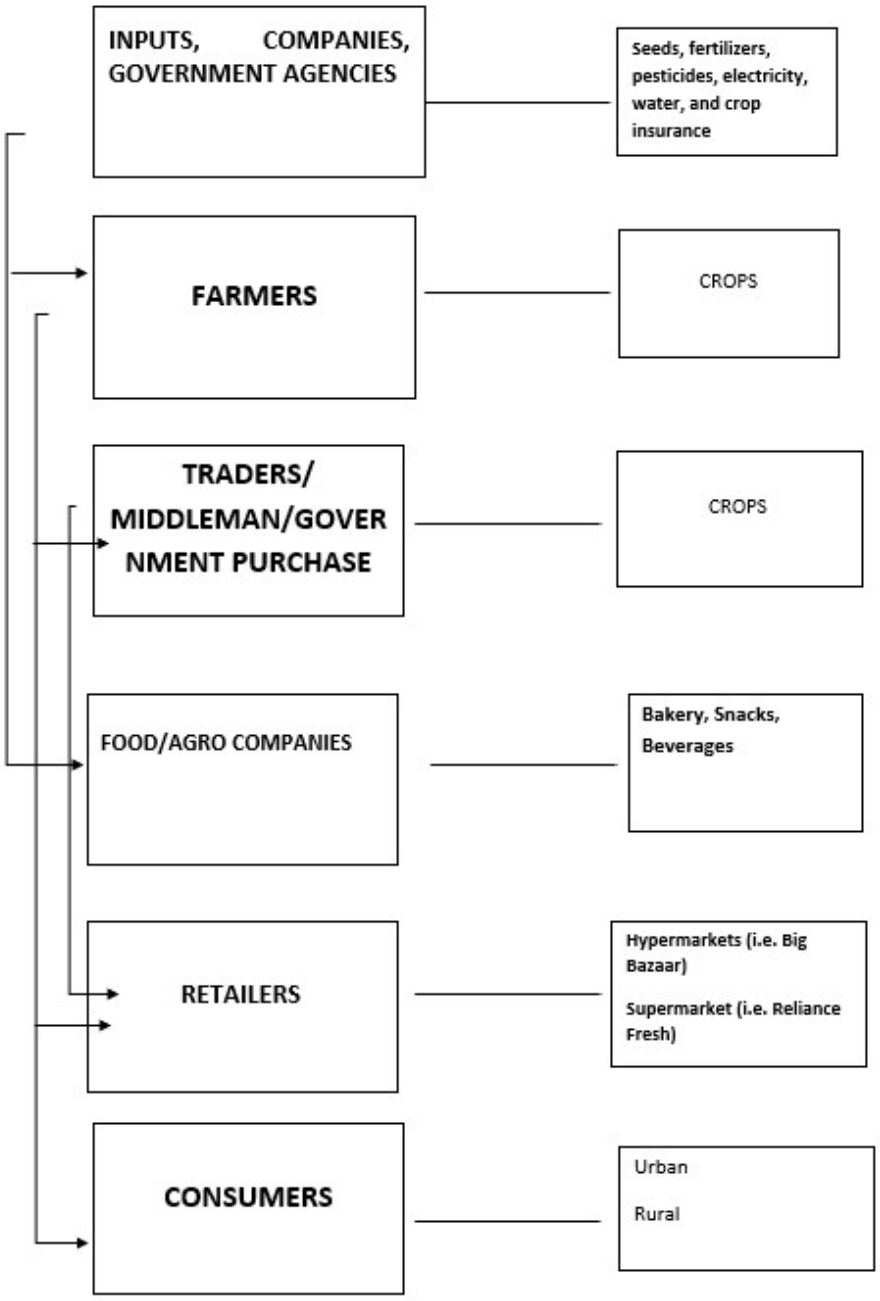


Figure 2.2: Agricultural Value Chain of Fruits and Vegetables in India

Source: Kumar and Shama (2016)

2.2.2. Agricultural Value Chain in South Africa

South Africa, as an emerging country, boasts vast fertile lands and favourable weather conditions in provinces such as Mpumalanga, Eastern Cape, and Western Cape (Anriquez, 2017). Consequently, agriculture plays a crucial role in the country's rural development, with smallholder farming forming a key component of strategies aimed at ensuring food security, poverty alleviation, and employment creation, in rural areas (Anriquez, 2017; Chisoro & Padayachie, 2023). In this context, the agricultural value chain has emerged as a central player in enhancing agricultural produce in the country. Phillips (2012) noted concerns regarding price inflation attributed to farmers and retailers, however, thanks to price control systems administered by the National Treasury, agricultural produce, particularly in largescale farming, has been fairly priced over the last five years. Smallholder farmers, despite this, faces challenges, such as undervalued crops and livestock, lack of market information, and underpayment by retailers or middlemen (Anriquez, 2017; Chisoro and Padayachie, 2023), thereby hindering their meaningful participation in the agricultural value chain. These challenges, in particular, smallholder farmers' lack of awareness regarding the quality criteria used by buyers to determine prices for their produce, have resulted in exploitation by buyers during processing and resale to end-users, due to inflated prices (Johann *et al*., 2018). Smallholder farmers, often perceived as price-takers, may consequently receive lower prices for their products due to their urgency to generate income. Additionally, inadequate and inaccessible marketing infrastructure forces these farmers, for instance, cattle farmers to travel long distances, increasing transaction costs, eroding their bargaining power, thereby diminishing their control over pricing (Conceicao *et al*., 2016; Mahlangu *et al*., 2020).

Similarly, Khapayi and Celleirs (2016) detail the dualistic nature of agriculture in Namibia, with its well-developed commercial sector dominated by white farmers and a poorly-developed communal or smallholder farming sector, mirroring the situation in South Africa. The smallholder farming sector is dominated by black farmers, whose produce is often deemed of inferior quality. Nonetheless, the potential to support smallholder farmers for long-term food security persists within the context of evolving modern food value chains, particularly in South Africa. In fostering a greener, low-carbon economy, conducive to job creation and improved human well-being, as part of sustainable and socially-inclusive economic development, should be driven, in part, by smallholder farmers: thus, characterizing and mapping the value chain of smallholder farmers, particularly in rural areas, is crucial for their advancement in the foreseeable future. Accordingly, understanding the elements that underpin the smallholder value chain, forms an essential aspect of the current study.

2.3. Mapping and Characterisation of Smallholder Value Chain

The transition of smallholder farming from a predominantly subsistence-based system to a commercially focused one, “smallholder transformation”, is increasingly becoming prevalent in rural areas (FAO, 2016). This shift represents a crucial aspect of a comprehensive economic evolution, particularly in developing countries, where a significant portion of the population is engaged in agriculture (Frederick, 2018; Chisoro and Padayachie, 2023). This transformation typically involves an initial increase in agricultural output, driven by greater input utilization and the adoption of more intensive farming techniques (Conceicao *et al*., 2016). Ideally, this evolution should lead to higher net farm incomes and stimulating economic activity beyond the agricultural sector in rural areas. Moreover, the development of value-added activities, such as agro-processing and retailing, which is linked to improved agricultural production, can further employment opportunities in rural regions (Jacques, 2019; Chisoro and Padayachie, 2023).

There is, however, a notable scarcity of literature focusing on the value chain, information asymmetry and productivity of smallholder farming, particularly in areas such as vegetable production, and despite this being one of the most common agricultural practices in rural areas, it remains inadequately documented in the literature. There is, therefore, a pressing need to investigate agricultural productivity within the context of smallholder farming, particularly in sub-Saharan Africa, including South Africa. Addressing this research gap is essential for informing policy decisions and initiatives aimed at enhancing agricultural productivity, livelihoods, and economic development in rural areas.

2.3.1. Agro-processing Level

Agricultural commodities produced by smallholder farmers undergo various processes of value addition. These farmers are primary producers of a wide range of commodities, including crops, fruits, and livestock, which are essential for daily consumption in rural areas (FAO, 2018; Trooster *et al*., 2020). Agro-processing, as a sub-set of manufacturing, plays a crucial role in the agricultural value chain, by processing raw materials and intermediate products derived from the agricultural sector (Phillips, 2012; Mmbengwa *et al*., 2020). Through value addition, agricultural commodities are transformed from their original state into new products.

Understanding the flow of products from farmers to agro-processors is essential. Recent discussions have highlighted concerns that farmers often sell their products to immediate stakeholders such as retailers and agro-processors at undervalued prices (Jacques, 2019; Mmbengwa *et al*., 2020). For instance, in a typical agricultural value chain scenario described by Phillips (2012), farmers receive inputs, such as seeds, fertilizers, pesticides, and water, as produce of their various products, and sell them to entities such as supermarkets and restaurants. Without

a well-established chain of participating entities, the added value of the products delivered to the end consumer may be limited (Tanumihardjo *et al*., 2019; Anastasiadis *et al*., 2020). The value chain functions as a mechanism that enables producers, processors, and traders, regardless of time and location, to collaborate towards a common goal, therefore, it is crucial to identify the key actors in the value chain - from producers to endusers - to gradually add value to products and services as they traverse through each link in the chain until they reach the final consumer, whether domestic or global.

2.3.2. Retail Value Chain

The retail value chain encompasses a series of activities that enable businesses to acquire products from farmers or produce them and subsequently sell these products to customers (Hanks, 2018). Each step in this chain contributes value to the overall process. According to Pratap (2018) and Rivaldy & Pratama (2023), the retail value chain involves various stages, such as product creation, inventory storage, and distribution to consumers. For smallholder farmers participating in this value chain, they must understand how each of these processes function, however, communal and small-scale farmers often lack comprehensive information about the retail value chain, which can result in either undervaluation or overvaluation of their products (Hanks, 2018; Anastasiadis *et al*., 2020). Farmers, therefore, need to have access to all relevant information, across the value chain to align their production practices with current market demands. This understanding will enable farmers to make informed decisions and effectively engage in the retail value chain, thereby optimizing their participation and ensuring fair pricing for their products.

2.3.3. Markets and Value Chain

Markets serve as the meeting point for buyers and sellers, where various products are rebranded and repackaged as part of the value chain (Pankowska, 2019; Anastasiadis *et al*., 2020). When smallholder farmers produce a variety of products, these goods are eventually brought to the market where stakeholders, including retailers and wholesalers, purchase and store these products for daily sales or future processing. Within the market, different players may engage in the repackaging and rebranding of products to align with market demands and specific customer preferences. This adaptation to consumer needs ensures that products are presented in a manner that maximizes their appeal and meets evolving market trends.

2.3.4. Consumers of the Crops

Agricultural commodities undergo various value-addition processes tailored to meet the specifications of end-users. The value of a product is generated through the contributions of multiple stakeholders who tailor the product to meet the specific requirements of end-users. The

value chain serves as a mechanism through which producers, processors, and traders enhance the value of products according to their capabilities and the specifications provided by the end-users (Frederick, 2018; Anastasiadis *et al*., 2020). As products progress along the value chain, information may be lost or distorted, leading to potential misinformation and eventual inefficiencies in the process (Hanks, 2018). When sellers receive products from farmers, they must ensure that these products are made available to end-users in a timely manner, in quantities and specifications that match demand. Failure to do so can result in either shortages, where products sell out quickly leaving customers unsatisfied, or surpluses, where excess inventory remains unsold on shelves, leading to revenue loss in the retail value chain (Hanks, 2018; Anastasiadis *et al*., 2020). Effective coordination between smallholder farmers and retailers or agro-processors is essential to ensure that all stakeholders in the value chain are well-informed and aligned. Strengthening this coordination can help optimize the flow of products along the value chain, minimize inefficiencies, and ultimately enhance the overall performance of the agricultural value chain.

2.4. Information-sharing Process and profitability of value chain

Information is regarded as a critical fundamental factor in farming and the value chain. For this study, several empirical literatures regarding information-sharing processes and the profitability of the value chain, were reviewed. First, focus is on the notion of information sharing followed by the profitability of farmers.

2.4.1. Information-Sharing Process

The information-sharing processes in value-chain management play a crucial role in linking stakeholders - producers, middlemen, manufacturers, retailers, and end-users (Mathu, 2019; Casali *et al*., 2020). This interconnectedness implies that producers should supply their products to various stakeholders only after relevant information has been shared across the value chain, including essential details about product transportation, processing, and market demand. The effectiveness of this process relies heavily on timely and relevant informationsharing both within and outside the enterprises involved. Hassan & Nasereddin (2018) examined the characteristics of information sharing in value chain management, highlighting its benefits and drawbacks. They found that, although shared information can foster lasting relationships and bring substantial benefits to trade, intentional leakage of information or withholding it may negatively impact the performance of stakeholders and create barriers to effective information-sharing, thereby, preventing the smooth functioning of the chain. Mathu (2018) emphasized the importance of supply chain association and integration in meeting customer requirements, particularly in the fast-moving consumer-goods sector. The author stressed that the success of producers in this sector is closely linked to the performance of leading retailers, who serve as their primary distribution channels.

Similarly, Casali *et al*. (2020) reiterated the significance of information-sharing in enhancing the response to customer needs within the value chain of South African food producers and retail stores.

Kaipa *et al*. (2017) conducted a study on information-sharing for sales and operations planning in the value chain context, focusing on solutions and mechanisms in Uganda. They developed actionable design propositions for collaborative sales and operations and implemented an information-sharing pilot project involving product manufacturers and retailers. The project demonstrated the positive impact of information-sharing on sales, operations, and planning mechanisms, leading to significant and visible benefits for both retailers and producers, as was supported by a later study by Schrobback *et al*. (2023).

Zhonghua and Ling (2018) conducted a comprehensive review of information-sharing in value chain management, particularly in the context of China. They illustrated that information sharing can enhance supply chain productivity by reducing inventories and streamlining production processes. Additionally, they isolated the types of shared-information capable of improving the value of different products and enhancing coordination among stakeholders. Their review recommended future directions for theory construction and empirical research in this area. Baihaqi and Sohal (2013) investigated the impact of information-sharing in value chains, on organizational performance. Their study examined various factors affecting the degree of information-sharing, including integrated information technologies, internal integration, information quality, and costs-benefits sharing. While integrated information technologies and information quality were found to have positive effects on the strength of information sharing, internal integration and cost-benefits sharing did not show significant relationships. Additionally, they discovered that information-sharing alone does not directly correlate with organizational performance but is mediated by teamwork practices with value chain partners.

Mashiloane *et al*. (2018) and Schrobback *et al*. (2023) conducted a study on - value chain dynamics, information-sharing, inter-organizational relationships, and supply chain performance - within the manufacturing sector, focusing specifically on South Africa. Their research unveiled an array of internal and external challenges confronting business value chains in South Africa, impeding their effectiveness. Notably, they identified the pivotal role of information in mitigating these challenges and enhancing the performance of supply and value chains. Drawing on empirical data gathered from manufacturing firms in Gauteng Province, they identified a significant positive correlation between the dynamism of value chains and both information-sharing and inter-organizational relationships. These studies reiterate the critical role of these elements in bolstering supply chain performance.

These reviews do confirm that the literature has extensively addressed information-sharing processes in various contexts, however, there remains a gap in understanding how these processes operate among smallholder farmers engaged in vegetable production, such as butternut and tomatoes, hence, the urgency of this research. These crops hold significance in multiple markets and exhibit considerable consumption levels; consequently, their situation prompts inquiries into whether smallholder farmers receive pertinent information regarding market prices, packaging requirements, and market dynamics for these products.

Additionally, there is a moral obligation to ascertain who reaps the benefits of the large-scale production of tomatoes and butternuts from rural areas. Addressing these queries underscores the necessity to compare the processes of value-creation and informationsharing for butternut and tomato crops, within the Nwanedi Agri-hub small-scale farming context.

2.4.2. Smallholder Farming Profitability and Value Chain

The primary objective of any system, production process, or machinery is to achieve maximum productivity while minimizing wasted effort or expenses (TCI, 2018; Steenwykn *et al*., 2022). Smallholder farming, being one of the most prevalent forms of agriculture in rural areas, therefore, is expected to operate productively and efficiently, consequently, numerous empirical studies have been conducted to explore this topic, as outlined in the following subsection.

Abdul-Rahaman and Abduali (2018) investigated the impact of farmer-groups on farm yields and profitability among smallholder farmers, particularly on the challenges faced by farmers in developing countries. Their study, based on survey data from 412 smallholder rice farmers in northern Ghana, utilized a sample selection stochastic production frontier model to account for potential selection bias. The results indicated that participation in farmer-groups was associated with increased yield and profitability, compared to farmers operating individually and that the yield and profitability gaps between group members and non-members widened significantly when considering selection bias in the analysis.

Ahmed *et al*. (2013) analyzed the profitability of farming households engaged in smallholder farming in the Girawa District of Ethiopia. Using cross-sectional data from 200 randomly selected households during the 2011/12 production season, they employed the Cobb-Douglas production function and stochastic production frontier approach to estimate profitability levels and identify factors affecting it. The findings revealed a profitability of 81.5%, indicating significant inefficiencies in farm production in the study area. Factors such as - education, livestock holding, extension contact, farmers' training, cultivated area, and access to irrigation - were found to positively influence profitability, while social status had a negative relationship. The study emphasized the

importance of improving profitability among less-efficient farmers by adopting practices of relatively profitability and directing government policies and strategies toward addressing key determinants.

Makombe *et al*. (2017) investigated the productivity and profitability of smallholder irrigation in Ethiopia, another country where agriculture plays a pivotal role in the economy, contributing over 40% to GDP and supporting approximately 80% of the population. Utilizing a stochastic frontier production function, the study analyzed four different agricultural production systems in Ethiopia, including traditional and modern communal irrigated sites, as well as rain-fed sites without access to irrigation. The sample comprised 434 farmers selected through simple random technical analysis. The results indicated that while the marginal productivity of land in modern communal irrigation systems indicated potential improvements, the rain-fed group without access to irrigation exhibited higher productivity compared to the traditional irrigated system. The study estimated an average technical profitability of 71% for the modern irrigated system and 78% for the rain-fed group, indicating room for enhancing cultivation profitability in both systems.

Dessale (2019) examined the technical profitability of smallholder wheat-growing farmers in the Jamma district of Ethiopia. Employing maximum likelihood parameter estimates, the study found that wheat output was positively influenced by factors, such as - land area, labor, fertilizer, and the number of oxen. The estimated mean technical profitability of the sample farmers was approximately 82%. Further analysis using a stochastic production frontier model revealed that variables, such as - improved seed, age, education, training, and credit - had a negative and significant impact on technical profitability, while, farm size, had a positive and significant effect. Dessale (2019) concluded that there is potential to increase wheat output by efficiently utilizing these input variables, hence, the researcher suggested that local government support, such as - formal and informal education, training, credit facilities, improved seed, and timely fertilizer supply - could further enhance wheat production.

The above empirical literature testifies that determining technical profitability is essential for small-scale farming. Whilst the majority of these authors concentrated on cereal growers in other parts of Africa, the case is different in South Africa, where the majority of smallholder farmers are into vegetable production, like farmers in Nwanedi. There is, however, little evidence in literature which speaks to smallholder farmers in vegetable farming value chain and information-sharing processes. Productivity for these farmers is imperative as they form the majority of farmers in rural areas, but little is known. It is, therefore, urgent to understand vegetable production value chains in Nwanedi Agriculture Park. Table 2.1 comparing tomatoes and butternut squash in terms of value added, information asymmetry, and profitability characteristics.

As shown in Table 2.1 Value added, information asymmetry, and profitability are the three key factors that are compared between tomatoes and butternut squash in the table. Because they can be turned into a variety of goods including sauces, pastes, and juices that satisfy a high level of customer demand, tomatoes bring a substantial amount of value to products. Farmers frequently have information asymmetry, though, and their sales methods may be hampered by their lack of knowledge about market pricing and demand for various types. On the other hand, farmers may have difficulties because they lack sufficient knowledge about the best ways to store butternut squash, which can have an impact on their profitability. Butternut squash also maintains a high market value, particularly when processed into soups and purees. Overall, while tomatoes have higher profit margins tied to their demand, they also face price volatility and spoilage risks; butternut squash typically offers more stable prices, making both crops viable but with varying advantages and challenges in profitability.

Table 2.1: Tomatoes and butternut value added, information asymmetry, and profitability characteristics

Characteristic	Tomatoes	Butternut Squash
Value Added	Processed into sauces, pastes, and juices; high market value for fresh and processed forms.	Can be sold whole or processed into soups and purees; retains good value when stored.
Information Asymmetry	Farmers may lack market insights on pricing and variety demand, affecting sales strategies.	Limited information on best storage practices can reduce market value and increase waste.
Profitability	High profit margins due to high demand; susceptible to price volatility and spoilage.	Generally stable prices, lower volatility; can be profitable with proper storage and processing practices.

2.5. Chapter Summary

Available literature has extensively covered value chains and information asymmetry, however, there remains a gap in understanding the information-sharing process among smallholder farmers who produce for the market, particularly focusing on vegetables which contribute significantly to food security. In an ideal value chain, information-sharing is essential for all stakeholders to enhance production systems and economic outcomes, however, in the small agri-business processes, there appears to be a lack of information, leaving farmers uninformed about market dynamics such as, prices, packaging, and market forces. It is, thus crucial to comprehend the information-sharing processes for smallholder farmers and their productivity, which warrants a comparison of value-creation and information-sharing processes between different crops, such as butternut and tomato, in Nwanedi Agri-hub smallscale farming.

Characterizing and mapping the value chain of smallholder farmers, particularly in rural areas, is vital for their development in the foreseeable future. Additionally, while determining profitability is crucial for small-scale farming, most literature has focused on cereal growers in other parts of Africa, neglecting the significant number of vegetable producers, like those in Nwanedi. These farmers form the majority in rural areas, hence, understanding their practices is essential, establishing the motivation for conducting this study. The upcoming chapter outlines the research methodology adopted in the current study.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. Introduction

This chapter outlines the methodology that was followed in the study. The sampling and data collection methods, as well as data analysis, types and sources are described. Ethical considerations adhered to in this study are explained. The following sub-section covers the description of the study area.

3.2. Description of the Study Area

Nwanedi Agri-Hub Development, situated southeast of Musina town in South Africa, serves as a vital agricultural initiative for emerging farmers in the region. Musina, located in the northern part of the country, shares its borders with Zimbabwe to the north and Mozambique to the east. This development initiative supports 150 out of a total of 214 smallholder farmers. Under the guidance of extension officers, these farmers are part of a marketing secondary cooperative, which comprises seven affiliated primary cooperatives. The primary crops cultivated by these farmers include tomatoes, butternuts, okra, and green beans. The produce is distributed to various markets, including – Tiger Brands, Alloy, Rhodes Venda, the National Fresh Produce Market, local and international hawkers, as well as local communities. Figure 3.1 illustrates the study area's geographical layout.

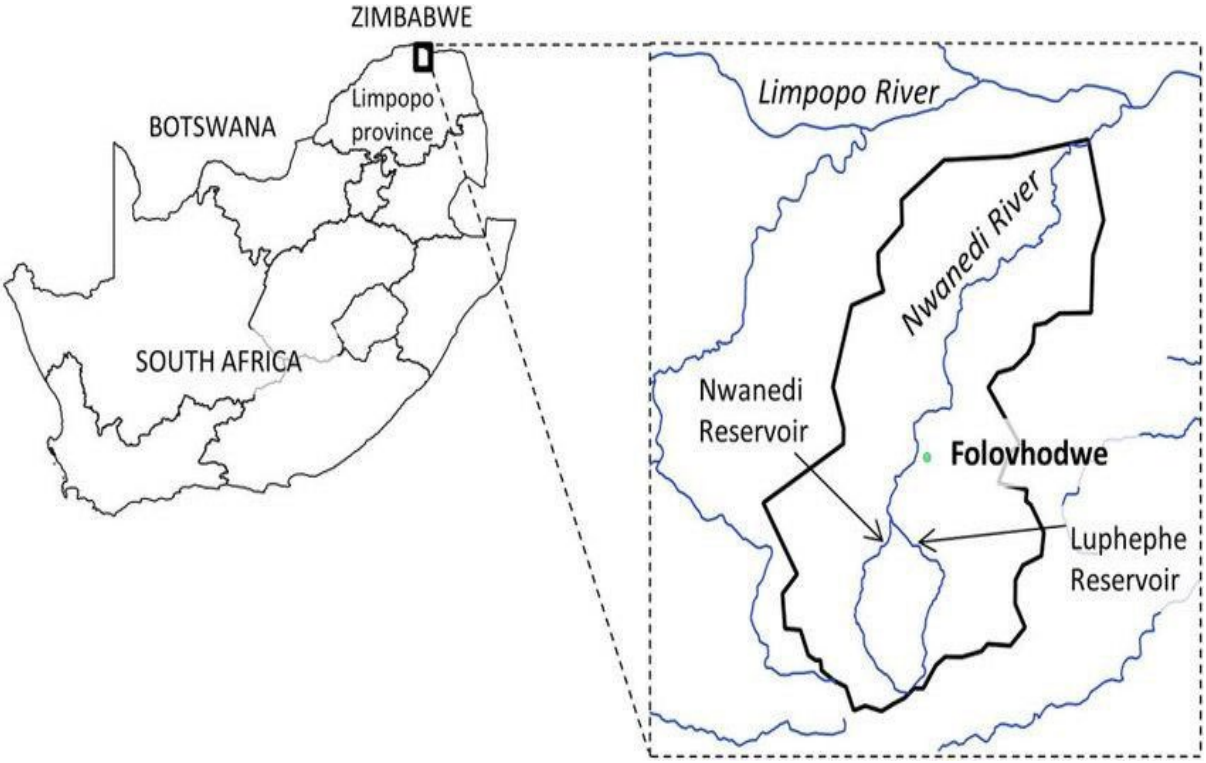


Figure 3.1 Map of Nwanedi Area

Source: Nwanedi Agri-hub:

- Farmer population: 214
- Beneficiaries: 150 Smallholder farmers
- Farmers organized into a secondary cooperative.
- Main crops: Tomatoes, butternuts
- Major markets: All Joy, Tiger Brands, Rhodes, Fresh Mark, and National Fresh Produce Markets

3.3 Research Design

The study adopted an exploratory sequential method design. This design is characterized by an initial qualitative phase of data collection and analysis followed by a collection of quantitative data (Berman, 2017; Toyon, 2021). The qualitative method was used to describe social relations, personal feelings, perceptions, and opinions, whereas the quantitative method was used to collect statistical data on price, farm income, marketing cost and production costs (Alshenqeeti, 2014; Covvey, 2024). A detailed explanation of all the research objectives and their corresponding data analysis methods and techniques are summarised in Table 3.1.

Table 3.1. Data collection and analysis methods

The objective of the study	**Research question**	**Data sources and sampling method**	**Data collection method, Techniques, tools and**	**Variables**	**Data analysis method and tools**
To characterize the value chains for tomato and butternut crops at Nwanedi Agri-hub.	What are the characteristics of the tomato and butternut crops' value chains for smallholder producers in Nwanedi Agri hub?	Smallholder farmers in Nwanedi Agri-Park, value chain players, Simple random and purposive sampling method in selecting smallholder farmers and value-chain actors, respectively.	Structured questionnaire	Information channels, marketing channels, value-chain actors	Mapping of value chains for tomato and butternut crops, using tomato supply chain and stakeholders; adapted from Anastasiadis *et al*, (2020)
To compare the value-creation and information sharing process of butternut and tomato crops in Nwanedi Agriculture Park.	How are value creation and information processes for tomatoes and butternuts compared at Agri hub?	Smallholder farmers in Nwanedi Agri-Park, value chain players, Simple random and purposive sampling method in selecting smallholder farmers and value-chain actors, respectively.	Structured questionnaire	Price, farm income, marketing cost, production cost	Average Gross Margin analysis was done for each crop's Value

To compare the profitability of tomato and butternut production at farm gate in Nwanedi Agri-hub.	How profitable are smallholder farmers in producing butternut and tomato crops in Nwanedi Agriculture Park?	Smallholder farmers in Nwanedi Agri-Park, value chain players, Simple random and purposive sampling method in selecting smallholder farmers and value chain actors, respectively.	Structured questionnaire	Price, farm income, marketing cost, production cost, information channels, marketing channels, value- chain actors	Same as above

3.4 Population and Sampling Procedures

The study's population encompassed 214 smallholder farmers, organized into 10 geographical clusters within the Nwanedi Agri-hub. A research population represents a collective group of individuals, circumstances, or entities that share similar characteristics (Indrayadi, 2020), exemplified in this study by the small-scale farmers at Nwanedi Agri-hub. These farmers cultivate various vegetables, including tomatoes, butternuts, okra, and green beans, as outlined in the Nwanedi Development Infrastructure Plan of 2014. Based on their common characteristic of vegetable farming at Nwanedi Agri-Park, the cluster sampling method was employed, selecting respondents randomly from each cluster; in the second phase, a total of 150 smallholder farmers were selected using simple random sampling, applying the Cochran Formula (Cochran, 1963) and the procedure outlined by Chaokromthong & Sintao (2021) based on the known population size.

3.4.1. Cochran Formula

$$\mathrm{N} = \frac{n}{1+\frac{(n-1)}{\mathrm{N}}}$$

Where n is Cochran's sample size recommendation (n=310) for an estimated population within the range of 200-300, N is the population size, and Ṡ is the new, adjusted sample size.

$$\mathrm{N} = \frac{310}{(1+\frac{(310-1)}{214})}$$

$$\dot{\mathrm{S}} = {}^{310}\Big/_{1+\frac{(310-1)}{214}}$$

$$= \frac{310}{2.44}$$

minimum sample size = 127

3.5. Data Collection

Data collection, as defined by Casley & Kumar (2016) and McLeod (2023), is the systematic process of gathering both quantitative and qualitative information regarding specific variables, aimed at evaluating outcomes or deriving actionable insights. In this study, data was collected through a survey method that involved distributing structured questionnaires to small-scale farmers at the Nwanedi Agrihub. The questionnaires were carefully designed to include both closed and open-ended questions, allowing for the collection of measurable data as well as more detailed, subjective responses from farmers about their experiences. The survey aimed to assess various aspects, such as agricultural practices, challenges faced, market access, and the impact of the Agri hub on their productivity and livelihoods. Before distribution, the questionnaire underwent a pilot testing phase to ensure clarity and relevance, which helped refine the questions based on the feedback received. Once finalized, the questionnaires were distributed during organized community meetings at the Agri hub, promoting participation and

allowing farmers to ask any clarifying questions. The data collected from this process was then analyzed to identify trends and correlations, providing valuable insights into the experiences of small-scale farmers and the effectiveness of the Nwanedi Agri hub in supporting their agricultural activities. Overall, this methodical approach to data collection ensured that the findings would contribute significantly to understanding the dynamics of small-scale farming in the region.

3.6 Data Analysis

Data analysis involves the examination of data using analytical and statistical techniques to extract valuable insights to support decision-making processes (Ali & Bhaskar, 2016; Skinner, 2020). In this study, the data was analyzed using the supply chain ratio analysis and the Stakeholder's framework, adapted from AnastasiadisI *et al*. (2020). This involved conducting gross margin calculations, value creation calculations, and determining the farmers' share. The assumption of Gross Margin Analysis is that the variable costs associated with production and marketing can be accurately identified and quantified, allowing for a clear calculation of profitability per unit sold. It also assumes that fixed costs will not significantly affect the decision-making process for pricing and production, focusing primarily on the contribution margin from sales. GMA is preferred because it provides a straightforward and effective way to evaluate the financial performance of different products, enabling farmers and businesses to make informed decisions about pricing, resource allocation, and operational efficiency. The analysis also included gross margin analysis, value creation, and farmers' share formulas as outlined by Islam *et al*. (2017). Market margin and net margin of value chain actors were estimated using the following formula:

$$GM_1 = P_{Ri} - P_{Pi} \quad \text{.....3.1}$$

where,

GM_i = Gross margin (Quintal vegetable farmers) for *ith* intermediaries

P_{Ri} = Price received (BDT/Quintal vegetable farmers) by *ith* intermediaries

P_{Pi} = Price paid (BDT/Quintal vegetable farmers) by *ith* intermediaries

$$NM_i = GM_i - MC_i \quad \text{.....3.2}$$

where,

where,

NM_i denotes the Net margin (BDT/Quintal vegetable farmers) for the *ith* intermediaries.

MC_i denotes the Market cost incurred (BDT/Quintal vegetable farmers) for the *ith* intermediaries.

Thus, Value addition (%) = $\frac{(sales\ price - Purchase\ Price)}{Purchase\ Price}$ x 100

In this regard, the farmer's share was calculated as;

Farmers' share = $\frac{(Price\ received\ by\ the\ farmer)}{Price\ paid\ by\ the\ retailer}$ x 100 .....3.3

The questionnaire required the mapping and characterizing of each crop, comprised the value creation and information-sharing processes, as well as the assessing of the impact of information asymmetry on the profitability of value chains. Specifically, the tomato supply chain and stakeholder's frameworks, adapted from Anastasiadis *et al*, 2020., were utilized for mapping and characterizing the value chains for tomato and butternut crops.

3.7 Ethical Considerations

The researcher adhered to ethical standards throughout the study, beginning with obtaining ethical clearance from the University of Venda Research Ethics Committee (SARDF/20/IRD/08/0212). Clearance was also sought from relevant authorities, including the Department of Agriculture and Rural Development, the Musina Municipality, and community leaders in Nwanedi. These measures ensured that all stakeholders understood the purpose of the study and were not harmed or prejudiced due to participating. Key ethical principles were followed during the data collection, and the writing of the report. One principle observed was voluntary participation which allowed participants not only to freely be part of the study, but to also withdraw at any time without coercion, should they wish to do so. The researcher, before the commencement of the study, provided clear explanations of the research's purpose and addressed any questions raised, objectively, to avoid undue influence. Confidentiality and anonymity were maintained to protect participants' identities and records; hence, pseudonyms and codes were used to conceal identities and ensure anonymity. Throughout the study, confidentiality was upheld in the handling of the collected data.

3.8. Chapter summary

The study's research methodology, including data collection and analysis techniques and ethical considerations, is described in Chapter 3. The Nwanedi Agri-Hub Development in Musina, South Africa, which assists 150 smallholder farmers growing products like butternuts and tomatoes, is the subject of the study. To obtain information on value chains and profitability, the study combines qualitative and quantitative techniques using an exploratory sequential research methodology. After 214 smallholder farmers were identified, 150 participants were chosen at random using a straightforward random sample technique. Structured questionnaires were used to gather data in order to document specific

farming practices and market trends. Analytical techniques, including gross margin calculations and stakeholder frameworks, were employed to analyze the data and determine financial viability. Ethical standards were rigorously maintained, with necessary approvals obtained from institutional and community authorities, ensuring participant confidentiality and voluntary involvement. Overall, this chapter lays a comprehensive foundation for understanding the study's methodology, highlighting its significance in examining smallholder farming dynamics within the context of the Nwanedi Agri-Hub.

CHAPTER 4
CHARACTERISATION OF NWANEDI BUTTERNUT AND TOMATOES PRODUCERS

4.1. Introduction

This section provides a comprehensive analysis of the socio-economic characteristics of participants at the Nwanedi Agri-hub, focusing on the variables - gender, education level, farming experience, age, and farm size. The findings highlight the predominance of female participants, the educational disparities between genders of the farmers, and the significant role women play in agriculture, particularly in the context of male migration. Additionally, the analysis reveals critical insights into land ownership patterns and the challenges posed by low youth-participation in farming, all of these variables have implications for food security and local economic development.

4.2. Results and discussion

This section presents the results regarding the characterisation of the participants in the study.

4.2.1. Socio-economic Characteristics

Table 4.1 displays the socio-economic characteristics of the participants. The results were based on analysis of many variables, including - gender, education level, farming experience, age, and farm size. Of the 150 participants in the survey, 57% were women, suggesting a significant majority of female farmers in the study area. This highlights the significance of analyzing gender dynamics in agriculture, a point substantiated by the current work. According to Glazebrook and Opoku (2020), women in economically-disadvantaged societies have a vital impact on maintaining food security by actively participating in agricultural practices. Tsvuura *et al*. (2021) reveal the susceptibility of households led by women to food insecurity because of the scarcity of formal job prospects, which forces females to depend heavily on agriculture for sustenance. Empowering women, therefore, is crucial for ensuring both food security and promoting local economic growth. As reported by Asmare *et al*. (2022), women in the Nwanedi region and other parts of Africa are more extensively involved in agricultural production than men. This occurrence is partially ascribed to the emigration of males in search of non-farming employment, resulting in women assuming agricultural duties.

Studies report low involvement of women in the agricultural value chain, however, Ejike *et al*. (2018) contend that in developing nations, women make a significant contribution to both farm and non-farm labor, nevertheless, it is also pertinent to acknowledge the inconsistencies in some of these research results, as pointed out by Muzekenyi (2022), specifically regarding the prevalence of male small-scale farmers as shown by the DAFF survey. In the survey, seventy percent of the respondents had completed

secondary education; 21% had completed primary education, while 6% did not have any formal education. When analyzing the educational attainment by gender, females had the highest proportion (53%) of individuals with secondary education. It may be deduced from this information that female farmers generally possess a higher level of education compared to male farmers. These findings contradict those of Siriwardana and Jayawardena (2014), which showed that male farmers performed better due to their diverse higher educational backgrounds. Baharielal *et al*. (2022) discovered a correlation between educational achievement in South African agriculture and the degree of commercialization when investigating the impact of socio-economic factors on farming methods and produce safety.

Both large-scale commercial and small-scale farmers, with financial means often have greater levels of education, including tertiary degrees, which allow them to utilize advanced technologies due to comprehending better the complexities of the value chain. On the other hand, farmers who have less resources sometimes have difficulties in employing highly-skilled workers which affects their ability to acquire timely relevant agricultural knowledge and make well-informed decisions along the value chain. The farming-knowledge gap is substantial, as discovered by Mapiye *et al*. (2023), causing smallholder farmers to significantly depend on government extension and consulting services to fill the knowledge deficit. The results from Maponya's (2021) study, however contradict the current findings, as the latter revealed a significant proportion of farmers with tertiary credentials. These differences are a clear indication of the intricate nature of educational interactions in the agricultural industry and the diverse obstacles encountered by various groups of farmers.

The bulk (77%) of farmers in Nwanedi Agri-hub have over 5 years of farming experience, hence, it can then be assumed that they have extensive experience in growing tomato and butternut crops. The mean age of farmers in the research region was 52 years, with the predominant age range being 51-65 years of which 62% were female respondents. In addition, 27% of the participants were aged 66 years or older, with 20% being male and 33% being female; the involvement of young people in agriculture is currently limited to a mere 3%, which might potentially jeopardize future food security. This issue has been highlighted in several studies, including those conducted by Hanks (2018) and Dhillon & Moncur (2023). Reiterating this point, Maponya (2021), points to a lack of involvement by young people in agriculture in the Vhembe District, which may be attributed to the belief that agriculture is not as appealing as other career choices. Female farmers have the largest average farm sizes, as they dominate land ownership in the 1-5 hectare and 5.1-10-hectare categories, representing 58% and 68% of landowners, respectively. In properties exceeding 10 hectares, male landowners are in the majority, accounting for 59% of ownership; in this larger category, the maximum land size owned by men reaches 100 hectares, while the largest owned by women is 43 hectares.

The average land ownership for male farmers is 15.23 hectares, whilst female farmers have an average of 11.14 hectares. This notable discrepancy in land ownership, influenced by gender, aligns with the results of Mitra, *et al*. (2023). Brixiová *et al*. (2020) contend that women's restricted access to land ownership impedes their entrepreneurial prospects because of the correlation between land ownership and loan access. Masuku *et al*. (2023), hence, recommend land policies for equitable land distribution to unlock economic potential and address gender disparities in land access and ownership in South Africa.

Table 4.1. Socio-economic characteristics of respondents

Variables	Male (frequency)	Proportion (%)	Female (frequency)	Proportion (%)	All farmers	Proportion (%)
Gender	65	43	85	57		
Educational level						
No formal education	4	44	5	56	9	6
Up to grade 7	8	26	23	74	31	21
Grade 8 – 12	50	47	56	53	106	70
Post matric	3	75	1	25	4	3
Farming experience						
1 – 2 years	1	50	1	50	2	1
2 – 5 years	14	42	19	58	33	22
>5 years	50	43	65	57	115	77
Age						
<35 years	4	100	0	0	4	3
36 – 50 years	16	80	4	20	20	13
51 – 65 years	32	38	53	62	85	57
> 66 years	13	32	28	68	41	27
Farm size						
<1ha	0	0	0	0	0	0
1 - 5ha	10	42	14	58	24	16
5,1 - 10ha	23	32	49	68	72	48
>10ha	32	59	22	41	54	36

Source: Author's survey (2024)

4.2.2. Characterization of the Value Chains for Tomato and Butternut Crops

In this study, the two major crops that were considered were tomatoes and butternut. The following section presents results and discussion for Farm gate value chain activities.

4.2.2.1. Farmgate Value Chain Activities

Year-round crops grown by the farmers include tomatoes, butternut squash, cabbage, chillies, and maize. Farmers cultivate both butternut and tomatoes at different periods of the year, as Table 4.2 illustrates. The growing season for tomatoes is from February to August, whereas the planting season for butternut squash is from July to December. When butternut is planted early in July, growers can benefit from a strong market demand in August and September. This is because competitors in Britz and Free State have less crops due to the cold, which creates a market shortage (Mabhaudhi, *et al*., 2018), as according to Ncedi SA (2022), butternuts are not grown in freezing temperatures but instead thrive in warm seasons, notably during the summer. Water scarcity is a widespread problem in the Nwanedi District, as well as in other areas of the Limpopo Province, therefore, farmers utilize drip irrigation systems due to their water, profitability, as well as their ease of maintenance. This preference is consistent with the findings of Elmurodov (2023), that farmers choose this micro-irrigation approach since it offers various benefits. These benefits encompass, higher agricultural productivity and enhanced crop quality, as well as the effective distribution of nutrients via irrigation systems, hence minimizing fertilizer loss and decreasing expenses related to land levelling. Drip irrigation reduces water use by 40 to 60%, by directly supplying water to plants, which also reduces weed development, (Mabhaudhi, *et al*., (2018), thereby, leading to additional savings on expenses for weeding and weed-control chemicals (Sihlobo and Qobo, 2021).

The agricultural value chain is essential in the production of food, as can be seen in the Nwanedi region. Here, farmers participate in two separate value chains for each commodity - one that is formal and one that is informal. Notwithstanding this separation, the principal participants in the value chains remain predominantly unchanged. The main cultivars grown are HTX 14 (Jam) tomatoes, along with Waltham and Pluto kinds of butternut squash, chosen according to market preferences. Tomatoes are distributed through many channels, such as the fresh market and processing sectors. Partially matured tomatoes, referred to as "champagne," are sold in their fresh state, while fully matured tomatoes are intended for processing, however, butternuts are solely distributed on the fresh market. The stakeholders in these value chains are input producers, farmers, bakkie merchants, hawkers, processors, wholesalers, retailers, and customers. Farmers typically focus on cultivating tomato and butternut crops for primary output, however, other participants in the value chain after obtaining the produce, enhance its worth through various methods, and distribute them until they reach the final customers.

Table 4.2. below provides a comprehensive depiction of the various entities involved in the value chain and the process of value chain mapping.

Table. 4.2: Commodities Grown in Nwanedi

Commodity	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Tomatoes												
Butternut												

4.2.2.2. Tomato and Butternut Value-Chain Actors and the Value-Chain Map

i. Farmers

Tomato and butternut value chains start with farmers buying inputs such as seedlings, fertilizers, chemicals, and providing labour which enable them to engage in the production of tomatoes and butternut crops. In this study, they are the focus in the tomato and butternut value chain, as primary producers, as such, the following stakeholders in the two-pronged value chain (informal sector) play a crucial role.

ii. Bakkie Traders

Bakkie traders are small-scale businesses that buy tomatoes and butternuts straight from the farmers and transport them to local markets or other distribution points, using pickup trucks or bakkies. These businesses play a critical role as intermediaries between farmers and consumers, thereby, helping to bridge the gap between production, processors, and consumers of farm produce.

iii. Hawkers

Hawkers are small-scale retailers or street vendors who sell tomatoes and butternut produce directly to consumers. The trade is conducted in the local markets, on street corners, or in other public places. In this study, hawkers play a significant distribution role for farmers to reach urban and peri-urban consumers with their tomatoes and butternuts.

iv. Processors

Butternuts and tomatoes are supplied to the processors by bakkie dealers and the farmers. Following this stage, those who process tomatoes and butternuts to create goods with greater value are referred to as “processors”. They generally perform operations such washing, drying, sorting, and packaging - to extend the shelf life, improve quality, or increase marketability of tomatoes and butternuts. Processors do obtain supplies from both the formal and informal markets, usually, by the bakkie dealers and farmers.

v. Fresh Produce market

Fresh Produce markets are privately owned by local governments; they provide a trading platform for fresh produce, by registered agents who act as middleman between a farmer and a buyer.

vi. Retailers

Companies or establishments that sell agricultural products to customers directly for consumption are known as “retailers”. Supermarkets, such as Shoprite, Spar, Food Lovers Markets and Boxers, are some of the retailers who are directly linked with suppliers who get butternuts and tomatoes from Farm Gate.

vii. Consumers

Consumers are people or households who buy agricultural products for their use or consumption. Fresh produce, processed foods, such as smoothies, tomato pastes, and other agricultural products, can be purchased directly from farmers, shops, or wholesalers.

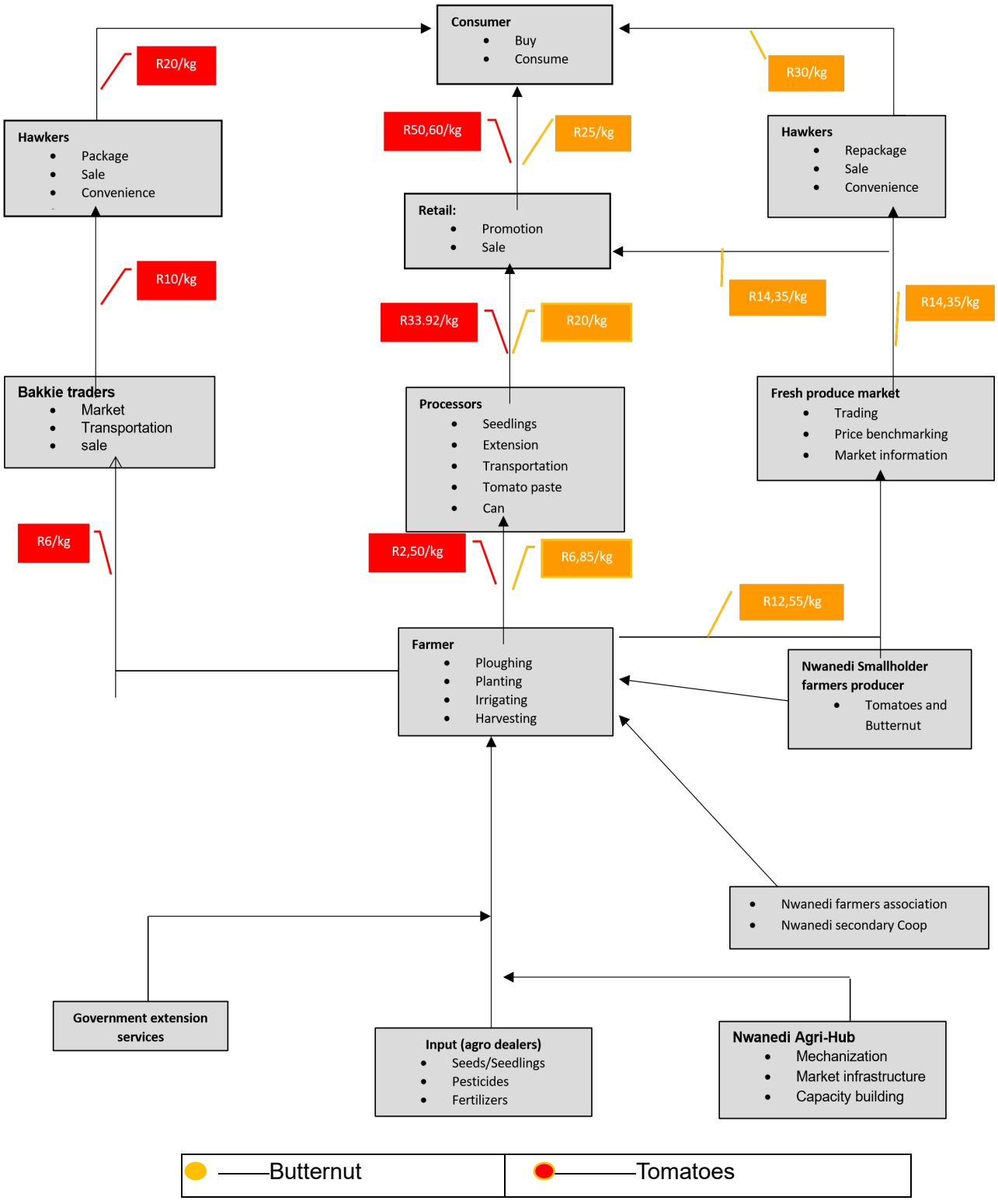


Figure 4.1. Value Chain Map of Tomatoes and Butternut

The analysis of value-creation activities for tomatoes and butternuts involves several stakeholders - input producers, farmers, processors (depots), distributors, retailers, and consumers. Figure 4.1 shows the commencement of value addition through agro-dealers, who play a vital role in supplying essential inputs, such as seeds, insecticides, and machinery needed for farming various crops. According to Shelar *et al*. (2023) and Anon (2023), using high-quality seeds and pesticides is crucial for obtaining excellent crop yields; this highlights the need for quality inputs in increasing value throughout this stage. Farmers typically rely on Agro-dealers for their inputs, by receiving guidance from organizations, such as the Nwanedi Cooperative and government extension programs. This reliance on agro-dealers is particularly evident in the tomato and butternut value chain in Nwanedi, where input costs play a key role.

Farmers procure inputs, such as seeds and fertilizers, at prices influenced by market conditions, with seeds and seedlings costing, approximately, R6/kg, and they also incur operational costs for ploughing, planting, irrigating, and harvesting. Farmers benefit from extension services provided by public authorities, such as the Limpopo Department of Agriculture and Rural Development in the Vhembe District. These services, alongside technical support from Nwanedi Agri-hub, enhance the value of their production, through market knowledge, mechanization of services, and capacity-building initiatives. Local labourers further contribute by performing tasks, such as planting, weeding, applying pesticides, and harvesting, thus enhancing the overall value of the farming process through their labour input. The Nwanedi Smallholder Farmers are organized into farmer associations, which advocate for their collective interests and facilitate knowledge exchange and skill development; this helps increase farmers' value and improve their capabilities. Farmers in the Nwanedi area sell their tomatoes at varying prices, typically around R10/kg at the Farm Gate, influenced by both fixed and variable costs, and subject to market forces such as supply and demand. Bakkie traders then purchase the tomatoes and butternuts at around R20/kg, adding value by transporting, packaging, and reselling them at higher prices at local markets or to street vendors. These traders often sell the produce at R25/kg to R30/kg to local hawkers or consumers, reflecting the value added by transportation and convenience.

Hawkers repackage the tomatoes and butternuts and sell them at even higher prices, sometimes, as much as R50/kg due to repackaging and providing convenience for consumers. Processors, other key stakeholders in the value chain, purchase the tomatoes at prices between R6/kg to R685/kg, depending on the level of value added, such as canning, mashing, and producing sauces or tomato paste. These products are sold to retailers at R12.55/kg, further increasing their market value. Retailers like Spar, Shoprite, Pick & Pay, and Checkers package the produce to meet consumer preferences and adhere to safety standards, selling tomatoes and butternuts at final prices of R14.35/kg to R33.92/kg, depending on quality and presentation.

The final prices paid by consumers reflect the total value added along the entire supply chain from input producers to retailers. Each segment contributes to the overall value creation, and the analysis shows that smallholder farmers are often at a disadvantage, during the process, due to information asymmetry and limited access to market information. This leads to farmers having lower bargaining power and reduced profitability, as intermediaries often capture a larger share of the final retail price. Value-creation at each step of the chain reflects the collaborative efforts and interactions that drive wealth generation. The smallholder farmers set the initial selling price based on their cost structure and market conditions, however, wholesalers, processors, and retailers further enhance the value and set their prices accordingly, highlighting the need for more equitable distribution of profits along the value chain. Value is added at each step, but the analysis shows that strategic interventions, such as improved market linkages, price stabilization mechanisms, and enhanced access to market information are crucial for ensuring that smallholder farmers capture a larger share of the value they create, thereby achieving long-term agricultural sustainability.

4.3 Chapter Summary

The value chain for tomatoes and butternuts involves various stakeholders, including input producers, farmers, processors (depots), distributors, retailers, and customers. Agro-dealers provide essential inputs like seeds, insecticides, and machinery for farming, while farmers rely on guidance from organizations like the Nwanedi Cooperative and government extension programs. The Nwanedi Agri-hub serves as a central location for market knowledge, offering mechanization services and capacity-building initiatives. Local labourers contribute to farming activities, and smallholder farmers are organized into farmer associations to advocate for their interests and develop skills. The local market is crucial for smallholder farmers, who sell their produce to street vendors and consumers. Processors acquire tomatoes and enhance their value through canning, mashing, and distributing sauces and pastes for retail consumption. Retailers like Spar, Shoprite, Pick & Pay, and Checkers provide additional value by customizing packaging to meet consumer tastes and food-safety standards. Customers ultimately buy tomatoes and butternuts from retailers, and the prices they pay represent the total value added along the entire supply chain.

The findings of this section indicate that the Nwanedi Agri-hub in the Vhembe District is home to a substantial number of small-scale commercial farmers, with a noteworthy representation of both genders. The present study reveals a rise in the participation of women in agriculture, challenging the previous decade's image of rural farming being predominantly male dominated. The results suggest that in this region, small-scale commercial farming is predominantly carried out by full-time farmers who practice mixed farming year-round. This approach aids in risk reduction by diversifying production between crops and livestock, as the majority of small-scale commercial farmers in the Nwanedi region depend on agriculture as their primary source of income. A significant number of these farmers,

however, have not obtained the essential agribusiness training required to improve their productivity. The question of land ownership continues to be a subject of concern, as the majority of farmers work on either community property or freehold land. The absence of secure land tenure is a substantial obstacle to agricultural progress, constraining farmers' ability to make enduring investments in their businesses. In addition, the bulk of these farmers mostly sell their agricultural products in nearby marketplaces, hence, lacking sufficient opportunities to access national and worldwide markets that could potentially yield larger profits and enhanced reputation.

CHAPTER 5
COMPARING THE VALUE CREATION AND INFORMATION SHARING PROCESS OF BUTTERNUT AND TOMATO CROPS' FARMERS

5.1. Introduction

Value creation involves determining the total revenue generated from the sale of a produce minus the total costs incurred during production; the difference represents the value created by each player throughout the value chain process. Marginal profit is calculated by subtracting variable costs from total revenue; variable costs include expenses directly related to production, such as seeds, fertilizers, insecticides, and pesticides (Islam *et al*., (2017). The resulting figure after all these processes indicates the profit generated from each unit of output beyond the variable costs. The farmer's share of the value created is determined by subtracting fixed costs (such as land, machinery, and variable inputs) from total revenue. This figure represents the portion of value remaining with the farmer, after covering both variable and fixed costs. By employing these calculation methods, the researcher was able to gain insights into the economic viability of tomato and butternut production at the farm level, as well as understand the distribution of value along the agricultural value chain.

5.2. Materials and Methods

To assess value creation along the tomato and butternut value chains at the farm level, the Gross Margin calculation method was employed. This approach considers various expenses incurred during production, such as - ploughing, seed procurement, fertilization, insecticides, pesticides, and irrigation, as highlighted by the researcher. According to Islam *et al*., (2017), value creation, marginal profit, and the farmer's share can be calculated using the following methods:

$$\text{Value-Addition percentage (\%)} = \left(\frac{\text{Sales price} - \text{purchase price}}{\text{Purchase price}}\right) \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$\text{Farmer's share to the consumer (\%)} = \left(\frac{\text{Price recieved by the farmers}}{\text{Price paid by the retailer}}\right) \times 100 \ldots\ldots\ldots(2)$$

$$\text{Gross Margin} = \text{Total revenue} - \text{Total variable cost} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$\text{Profit margin} = \frac{\text{Total Revenue} - \text{Total Cost}}{\text{Total Revenue}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

- Equation 1 depicts the value addition percentage of Nwanedi smallholder farmers, and it is calculated as - the increase in the value of each farmer's agricultural products achieved through processing, packaging, or other means before the produce is sold to the next

purchaser in the value chain (for instance, bakki traders, hawkers and processors), hence, the percentage essentially measures the extent to which the farmers have added value to their raw agricultural produce.

- Equation 2 depicts that smallholder farmers' share to the consumer is the portion of the selling price that farmers receive for their tomatoes and butternuts after all intermediary costs have been deducted. In terms of smallholder farmers, this value represents the amount of cash that goes back to them from the sale of tomatoes and butternuts to consumers.
- Equation 3 depicts the gross margin of a smallholder farmer, which is the difference between the total revenue generated from the sale of tomatoes and butternuts and the total variable costs incurred in producing those products. In essence, the equation denotes the money left over after accounting for the direct costs associated with the production of tomatoes and butternuts.
- Equation 4 depicts the profit margin of a smallholder farmer as a financial metric that indicates the percentage of revenue that remains as profit after all expenses, including both variable and fixed costs, have been deducted from total revenue. This process measures the profitability of the farming operation by expressing the profit as a percentage of the revenue.

5.2.1. Results on Value Addition activities: Farm Gate Level (Formal Market)

The data was collected from the farmers, which indicated that each farmer incurred an average expense of R64 781,63 per hectare. This included - labor costs, input costs, land preparation, irrigation, packaging and storage, as well as transportation. For the gross income per farmer, the calculated amount was R88 411,61 per hectare. As such, the selling price for each farmer was calculated as follows.

Selling Price = Total Production Costs × (1 + Profit Margin Percentage) ……. (5)

where:

- Total Production Costs: Average cost per hectare multiplied by the number of hectares per farmer.
- Profit Margin Percentage: The desired profit margin as a percentage of the total production costs (expressed as a decimal).

a) Total production cost per farmer = R64 781,63

b) Profit margin percentage = $\left(\frac{\text{R88 411,61} - \text{R64 781,63}}{(\text{R88 411,61})}\right)$

= 0,2673 x 100

- Profit margin percentage = 26,73%

The profit margin percentage per farmer is 26.73%. To calculate the selling price, equation 5 presented above was used.

a) Selling price per farmer = R336 216,66 x (1 + 0,2673)

= **R426 087,37**

To determine the selling price per Kg, the total selling weight of tomatoes produced on 1 hectare is determined.

5.2.2. Calculations: Farm gate

Converting the weight of tomatoes from tonnes to kilograms makes it easier to compare weights with other commodities that are measured in kilograms. It also simplifies conversion into smaller units, like grams, if necessary, thus, for easier comparison and conversion, the following subsections show the calculations used:

- Weight of Tomatoes (kg) = Weight of Tomatoes (tonnes) / 1000 kg
- Weight of Tomatoes (kg) = 38838 tonnes / 1000 = 38,838 kg

i. Calculate the total weight of tomatoes produced from the given hectares:

a) Total Weight of Tomatoes (kg/hectare) = $\frac{\text{Weight of Tomatoes (kg)}}{\text{Total Hectare}}$

b) Total Weight of Tomatoes (kg/hectare) = ($\frac{38{,}838\ \text{kg}}{5.19\ \text{hectares}}$) (given the fact that the total yield is 38,838 kg per farmer per 5,19 hectares).

= 7 483,23 kg per hectare

Now, to find the selling price per kilogram:

c) Selling Price per Kilogram = $\frac{\text{Total Selling Price}}{\text{Total Weight of Tomatoes (kg)}}$

d) Selling Price per Kilogram = $\frac{\text{R426 087,37/ 5.19)}}{7.48\text{kg}}$

= $\frac{82.1}{7.48}$

= **R10,98**

While the selling price of R10,98 should be what farmers at Farm Gate are pegging, the collected data showed that each farmer is selling a kilogram of tomatoes at a price of R6.

5.2.3. Value addition percentages (Farm gate)

Primary production activities are carried out at the Farm Gate, where input costs include - labor input, fertilizer and chemical application, soil preparation, electricity use, and transportation logistics. All of these activities assist value creation, as noted by Joumri and Labar (2023). There is variety in the ways that the input values are determined in this chain. Certain farmers at the farm gate purchase inputs from regional and national vendors, frequently reaping the advantages of government grants (Mthembu, *et al.*, 2022). As an alternative, the government occasionally pays local farmers directly at the farm gate for inputs. A straightforward value chain for tomato distribution from the farm gate to the final user (consumers) is shown in Figure 5.1. The information provided illustrates how prices rise through various middlemen from the farmgate to the final customer.

a) Tomato Farmer: Farm gate

The farmer is the primary producer of tomatoes and sells them at a price of **R6/kg** (100% of the base price). The price of R6/kg includes operational cost-plus markup, hence, is the amount the farmer earns per kilogram of tomatoes sold to the bakkie traders.

b) Bakkie Traders

Once the tomatoes have been harvested by farmers at the farm gate, the tomatoes are purchased by bakkie traders, who act as an intermediary and move the product from the farmer to the next level of distribution (Hawkers). The bakkie traders buy the tomatoes at **R6/kg** from the farmer and resells them at **R10/kg** to hawkers, making a 66.67% profit on each kilogram.

The 66.67% represents the mark-up the bakkie traders apply to the original price to cover their costs (for instance, transportation and storage) and earn a profit.

5.2.2.1. Information Asymmetry in the Tomato Value Chain

Once the tomatoes are harvested at the farm gate, bakkie traders purchase them from farmers and serve as intermediaries, facilitating the movement of the product to the next stage of distribution, which involves hawkers. The bakkie traders buy the tomatoes at **R6/kg** from the farmer and resell them to the hawkers at **R10/kg**, realizing a **66.67%** profit on each kilogram. This price disparity displays one example of the effects of information asymmetry, as farmers may lack access to market information,

including demand and pricing at the different levels of the supply chain (Hong, *et al*., 2023). This gives intermediaries, like the bakkie traders, a significant advantage in setting prices and determining profit margins. This lack of market information, at the farm gate, demonstrates that farmers often operate with limited access to market intelligence, such as, the final retail prices, consumer demand trends, and the value added by intermediaries. This situation limits farmers' bargaining power, as they may not be aware of the true market potential of their product beyond the farm gate, resulting in farmers typically accepting lower prices (**R6/kg**) offered by the bakkie traders. This initial transaction shows that intermediaries, like the bakkie traders, on the other hand, are better informed about market conditions and can leverage this knowledge to negotiate lower purchase prices from the farmers while selling at higher rates (**R10/kg**) to the next link in the chain, such as the Hawkers. Their control over logistics and access to multiple buyers gives them the upper hand in setting favourable terms for themselves.

Cost and demand information is also highlighted when the bakkie traders are aware of both the wholesale price they pay to farmers at farm gate and the retail price hawkers can charge in the market; this enables them to mark up the price (**66.67%**) when selling to hawkers. In contrast, hawkers may not have the full scope of market information, particularly regarding the original cost of tomatoes at the farm level, which further perpetuates information asymmetry. Farmers vulnerability is shown through lack of accurate and timely information on market trends; farmers remain vulnerable to exploitation by intermediaries who capture a significant portion of the profit. In this case, the farmer is only earning R6/kg, while the consumer is eventually paying **R20/kg** for the same tomatoes. This significant markup along the value chain underscores the farmers' lack of access to broader market dynamics and the value being created by the middlemen. Price Inflation occurs when consumers, who pay the final price **(R20/kg**), are also indirectly affected by information asymmetry. According to Frederick (2018), consumers are unaware of the significant difference between the price paid to the farmer and what they are charged at the retail level. This price inflation, therefore, may be attributed to intermediaries capitalizing on the lack of transparency, due to lack of information, between the different stages of the supply chain.

Hawkers who are street or informal vendors, buy the tomatoes from the bakkie traders at **R10/kg** and sell them at a final price of **R20/kg** to consumers; this results in a 100% profit margin for the Hawkers. The hawkers' role is to bring the tomatoes to the end consumers in local markets or street stands (consumers). Consumers purchase the tomatoes at the final price of **R20/kg**, which is significantly higher than the original price the farmers at farm gate received. The cost has increased along the value chain as intermediaries have added their markup to cover costs and generate profits.

a) Price Escalation

Farmer's price: R6/kg →bakkie traders

Bakkie trader's price: R10/kg (66.67% markup) →hawkers

Hawker's price: R20/kg (100% markup) → end-users

The diagram highlights how the prices escalate as tomatoes move through the value chain - from farmer to consumer - with each intermediary adding a significant markup to the original price. It also displays the disparity between what the farmer earns and what the consumer ultimately pays.

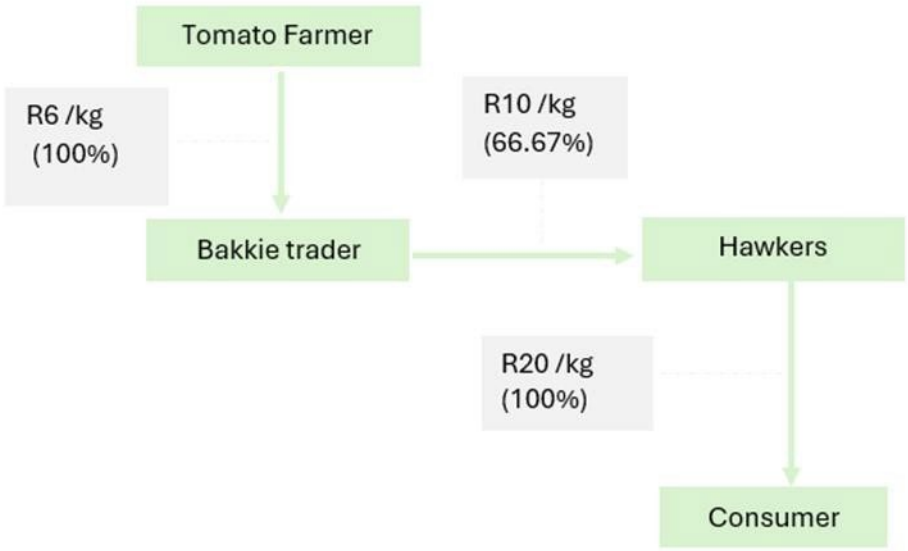


Figure 5.1: Informal market-destined value chain for tomatoes

In relation to the previous narration, bakkie traders play a crucial role in linking farmers with broader markets by aggregating tomatoes from various farms and handling logistics. They purchase tomatoes at a low price (R6/kg) and resell them at a higher price (R10/kg), ensuring market access for smallholder farmers and contributing to their livelihoods. Information asymmetry, however, arises at this stage, as farmers often lack access to market intelligence regarding the true value of their produce in the urban areas. This imbalance allows bakkie traders, who are better informed about market prices and demand trends, to negotiate lower prices with farmers while capturing a significant portion of the value through their markup. Similarly, hawkers act as intermediaries between bakkie traders and consumers, enhancing value by providing accessibility and convenience, through sorting, cleaning, and packaging the tomatoes to attract customers. Hawkers also benefit from the information asymmetry, by setting a retail price (R20/kg) that the end consumers are willing to pay, without them knowing the initial cost paid to farmers.

The value addition by both bakkie traders and hawkers not only reduces post-harvest losses but also ensures that fresh produce reaches urban consumers efficiently, yet, the lack of transparency in the value chain leads to an uneven distribution of profits, where farmers earn significantly less compared to the final market price. This process aligns with Agdede *et al*. (2023), who explains that value addition at each level of the tomato value chain, promotes economic development and sustainable agricultural practices, although addressing information asymmetry is critical to ensure that farmers receive a fair share of the final market price - this would ultimately contribute to improved livelihoods and competitiveness. As suggested by Grabs and Carodenuto (2024), recognizing the importance of value addition while also mitigating the effects of information asymmetry will help policymakers formulate strategies to strengthen the entire value chain. Such strategies could include providing farmers with real-time market information, thereby, improving their bargaining power, and promoting fairness among all actors, from farmers to consumers. Clarifying the activities, profit margins, and addressing the information gap at each stage, especially, in the transition from R6/kg to R20/kg would provide further transparency and help distribute the value more equitably across the supply chain.

5.3. Formal Market-Destined Value Chain of Tomato

Figure 5.2 shows the value chain for tomatoes, highlighting the price progression from the farmer to the final consumer through different stages, including processing at the Nwanedi Agri-hub and retail. Below is a detailed explanation of the value chain and the calculations behind the price changes:

a) Tomato Farmer

The farmer sells the tomatoes at R2.50/kg, representing 100% of the base price that the farmer earns for each kilogram produced, however, due to information asymmetry, farmers often lack access to

market data on exactly how much their product is worth after processing, putting them at a disadvantage in price negotiations.

b) Processing (Nwanedi Agri-hub)

Once the tomatoes are processed at the Nwanedi Agri-hub, their price rises significantly to R33.92/kg, a 1256.8% increase from the initial farm gate price. This drastic increase illustrates the value-added during processing, but also highlights the information asymmetry where farmers remain unaware of the substantial price mark-up that occurs further along the value chain, preventing them from fully capturing the benefits of their produce. The above presented prices were calculated as follows. Percentage increase from the farm gate to processing:

$$\text{Percentage increase} = \frac{\text{Processed price} - \text{Farm price}}{\text{Farm price}} \times 100$$

Substituting the values.

$$\text{Percentage increase} = \frac{33{,}92 - 2{,}50}{2{,}50} \times 100 = 1256{,}8\%$$

The R33.92/kg reflects the added value from processing, which includes costs related to sorting, cleaning, packaging, and preparing the product for retail.

c) Retail

The processed tomatoes are sold at retail for R50.60/kg, marking an additional price increase of 49.16% over the price, after processing. Information asymmetry plays a significant role here, as farmers and even some processors, may not have full information on how much the final retail price escalates. Retailers benefit from access to consumer-demand trends and market insights, allowing them to set higher prices. Meanwhile, farmers, who lack this critical market information, miss out on the potential to negotiate better deals or capture a larger share of the value created along the supply chain.

The above prices were calculated as the percentage increase from processing to retail:

$$\text{Percentage increase} = \frac{50{,}60 - 33{,}92}{33{,}92} \times 100$$

Substituting the values:

$$\text{Percentage increase} = \frac{50{,}60 - 33{,}92}{33{,}92} \times 100 = 49.16\ \%$$

This increase includes the markup from the retail sector, which accounts for the distribution, storage, and profit margins associated with selling the product to the final consumer.

d) Consumer

The final consumer pays R50.60/kg for the tomatoes, significantly higher than the initial R2.50/kg paid to the farmer. This increase reflects the cumulative value added through processing and retail, including costs, such as transportation, packaging, and retail overhead, however, the gap between these prices is also influenced by information asymmetry. Farmers offer no input into the final retail price and the factors driving these markups, which limits their ability to negotiate higher prices for their produce. Conversely, information symmetry would allow farmers to access real-time market data, enabling them to understand how much value is being added downstream and empowering them to demand fairer prices for their products.

5.3.1 Information Asymmetry in the Tomatoes Trade

In the value chain, information asymmetry plays a significant role in how value is distributed among the actors, especially between farmers, processors, and retailers. Farmers sell their tomatoes at R2.50/kg, which represents 100% of their earnings per kilogram, however, due to information asymmetry, farmers are often unaware of the prices their produce can fetch after processing and retail. Without access to critical market information, farmers remain at a disadvantage when negotiating prices, leaving them with a smaller share of the value chain.

After being processed at the Nwanedi Agri-hub, the price of tomatoes jumps to R33.92/kg, representing a 1256.8% increase. This substantial markup is a result of the processing value added, such as cleaning, sorting, packaging, and other logistical costs, however, the large gap between the farm gate price and the processed price can be attributed to the fact that processors have better access to market information, enabling them to capture much of the value created. Farmers, on the other hand, lack this insight, reinforcing the imbalance created by information asymmetry.

The final retail price of R50.60/kg is a further 49.16% increase from the processed price. Retailers benefit from advanced market knowledge, such as consumer demand trends and competitive pricing strategies, allowing them to determine profitable price points. Meanwhile, farmers, and sometimes even processors are excluded from this information, leaving them unable to benefit proportionately from the additional value created in the final stages of the supply chain. Information asymmetry limits the ability of farmers to negotiate fairer prices and gain access to the full economic value of their produce as it moves through processing and retail stages. Providing farmers with better market information could help bridge this gap, ensuring a more equitable distribution of profits along the value chain.

e) Price Escalation

Farmer's price: R2.50/kg (100%) → Nwanedi Agri-hub

Processed price (Nwanedi Agri-hub): R33.92/kg (1256.8% increase) → retail

Retail price: R50.60/kg (49.16% increase from processing)

The diagram illustrates the sharp price increase at the processing stage, where the tomatoes' value jumps from R2.50/kg to R33.92/kg, driven by the significant value addition during processing. The additional markup at retail further increases the price to R50.60/kg, highlighting the role of both processing and retail in inflating the final cost to consumers.

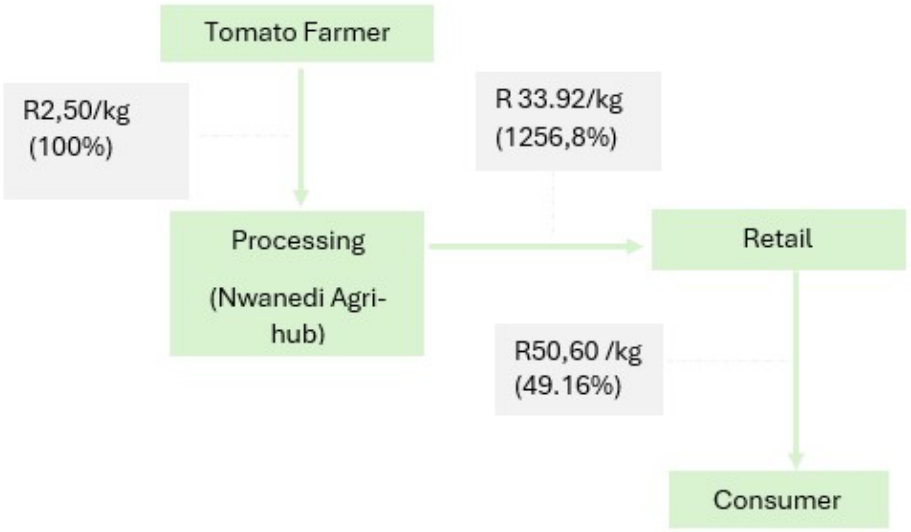


Figure 5.2. The Formal Market-destined Value Chain for Tomatoes

Hambloch (2022) highlights the significant risks faced by processors in the tomatoes processing value chain and stresses the importance of addressing their concerns, including issues such as the import of tomatoes from China, inadequate market research, the need for guaranteed pricing, and ensuring sufficient processing inputs. Additionally, Darakeh *et al*. (2021) raise concerns over contract violations, unfair pricing practices, and recommending the necessity of stronger government oversight in agricultural contract farming agreements.

In Nwanedi, both the informal and formal markets are viable for smallholder farmers, but the informal sector typically has a shorter, less complex value chain. This sector usually involves fewer intermediaries, with farmers engaging in activities like farming, harvesting, and direct selling to consumers or small-scale traders. Aji *et al*. (2023) explain that smallholder farmers often generate more profit in the informal sector due to price variations and fewer actors in the value chain. Similarly, Uzhenyu (2022) notes that smallholders in Zimbabwe thrive in the informal sector because economies of scale favour large-scale farmers in the formal market. In contrast, the formal sector has a more extended and intricate value chain (Rohit, 2023), involving multiple stages such as, production, processing, packaging, distribution, and retailing. Numerous actors - farmers, processors, wholesalers, and retailers - add value at different stages. These actors engage in activities such as washing, sorting, grading, slicing, and packaging into consumer-friendly formats like cans, bottles, or pouches. Eslami *et al*. (2023) note that processed products, such as paste, sauce, or diced tomatoes, offer added value and convenience for consumers.

There is a broader market access provided by formal channels, through established retail outlets, supermarkets, and food service providers, despite this, smallholder farmers in Nwanedi face limited interactions with processors. Unlike in Botswana, where smallholders can access both local and national formal markets (Ferris *et al*., 2021), farmers in Nwanedi are largely restricted to informal markets. The formal sector, however, offers significant economic benefits, such as job creation, tax revenue generation, and contributions to GDP growth. Investments in processing facilities, technology, and quality-control measures enhance productivity and competitiveness in the formal sector, driving profitability and longterm development, although, information asymmetry plays a critical role in both the informal and formal market segments. In the informal market, smallholder farmers often have better access to direct market information, enabling them to negotiate prices more effectively and capitalize on local demand. They have more transparency and direct engagement with consumers or small-scale traders. On the other hand, in the formal sector, farmers face a disadvantage due to limited access to critical market data. This data. such as - pricing trends, demand forecasts, and the value of processed goods - is often controlled by processors, wholesalers, and retailers. Such information asymmetry prevents smallholder farmers from fully benefiting from the formal market's broader reach and higher value addition, leaving them with reduced bargaining power and lower profits. As such, while the informal sector in Nwanedi offers immediate profitability and simplicity for smallholder farmers,

addressing information asymmetry in the formal sector could enable their more equitable participation. Providing farmers with better access to market data could help them negotiate better deals, maximize value, and unlock further opportunities for growth and development across the entire value chain.

5.4. Value added at the input level: Butternut

The data was collected from participating butternut farmers and each one incurred an average expense of R55 387,40 per hectare. As such, the selling price for each farmer has been calculated as follows.

Selling Price = Total Production Costs × (1 + Profit Margin Percentage) ……. (5)

Where:

- Total Production Costs: Average cost per hectare multiplied by the number of hectares per farmer.
- Profit Margin Percentage: The desired profit margin as a percentage of the total production costs (expressed as a decimal).

Calculation	Formula	Intermediate Result	Final Result
Total Production Costs	Total Production Costs = Average Cost per Hectare × Total Hectares	R55,387.40 × 4	R221,549.60
Profit Margin Calculation	Profit Margin Percentage = (R65,000.00 / R221,549.60) × 100	Approximately 29.36%	29.36%

Profit margin percentage = **29.36%**

The profit margin percentage per farmer is approximately 29.36%. The total production cost per hectare, calculated at R55,387.40 for 4 hectares per farmer, is relatively low compared to the potential revenue generated from the yield. Assuming a potential revenue of R500,000.00 per hectare, this indicates a substantial difference between the cost and revenue. While the profit margin is lower than previously stated, production costs are still significantly outweighed by the generated revenue, demonstrating a profitable operation for the farmers.

The actual selling price is calculated as follows,

Calculation	Formula	Intermediate Result	Final Result
Selling Price per Farmer	Selling Price = Total Production Costs × (1 + Profit Margin Percentage)	R221,549.60 × (1 + 0.2936)	R286,505.10

To determine the selling price per Kg, the total selling weight of butternut produced on 47,3 hectares was calculated.

Calculations

i. Converting the weight of butternut from tonnes to kilograms.

Calculation	Formula	Intermediate Result	Final Result
Total Weight of Butternut Produced	Weight of Butternut (kg) = Average Yield per Hectare × Total Hectares	20,000 kg/hectare × 4.7 hectares	94,000 kg
Selling Price per Kg	Selling Price per Kg = Selling Price per Farmer / Total Selling Weight	R286,505.10 / 94,000 kg	R3.048

Selling Price **= R3,04**

The actual selling price for butternut per kg should be R3.04 as per the data shown above, however, on the ground, farmers are selling at R14,35 per kg (LDARD, 2023); this implies that farmers are over pricing butternuts. In order to understand this price over pricing, it is pragmatic to assess the value chain of butternut at Nwanedi Agri-hub. The butternut value chain begins with the essential role of farmers, who are primarily engaged in the production of butternut at the farm level. The price change per each segment is shown below.

a) Butternut Farmer

The butternut farmers sell the produce at **R12.55/kg**, which represents 100% of the base price that they earn for producing and selling the butternut. This is the starting point of the value chain, and all subsequent price changes will be measured against this base price.

b) Fresh Produce Market

The butternut is sold at the Fresh Produce Market for **R14.35/kg**. The price increase from the farmer to the market is calculated as follows:

Price Increase:

$$\text{Increase} = \frac{(14{,}35 - 12{,}55)}{12{,}55} \times 100 = 14{,}33\% = 14\%$$

This 14% increase reflects the cost of logistics, handling, and the Fresh Produce Market's margin. It shows how much the price has increased from the farm gate to this intermediary. **c) Hawkers**

Hawkers purchase the butternut from the Fresh Produce Market at **R14.35/kg** and sell it to consumers at **R30/kg**. The percentage increase from the market price to the hawkers' selling price is calculated as follows:

Price Increase:

$$\text{Increase} = \frac{(30-14{,}35)}{12{,}55} \times 100 = 139\%$$

The hawkers apply this markup due to the convenience they provide by bringing the product directly to local consumers, as well as compensating for their transport and operating costs.

a) Retailers

Retailers also buy butternut squash from the Fresh Produce Market at **R14.35/kg** and sell it to consumers at **R25/kg**. The percentage increase from the market price to the retail price is calculated as follows:

$$\text{Increase} = \frac{(25-14.35)}{12{,}55} \times 100 = 74{,}2\%$$

however, as with hawkers, the **43% increase** shown in the diagram refers to the markup relative to the **farmers' price**. The percentage increase from the farmer's price to the retail price is calculated as follows:

- **Price Increase (Retail from Farmer)**:

$$\text{Increase} = \frac{(25-12{,}55)}{12{,}55} \times 100 = 74{,}2\%$$

Retailers add value by ensuring quality control, packaging, and branding, which often justifies their markup.

b) Consumers

Consumers can purchase butternut either from hawkers or retailers:

Hawkers sell at R30/kg, reflecting a **139% increase** from the farmer's price.

Retailers sell at R25/kg, reflecting a **99% increase** from the farmer's price.

Consumers pay these higher prices because of the value added by the intermediaries, whether it is the convenience provided by hawkers or the formal, consistent quality offered by retailers.

5.4.1. Information Asymmetry in the Butternut Value Chain

Farmers can convert their inputs into butternut products, which ideally should be priced at R3.048/kg based on their production costs. However, due to market dynamics, farmers deliver their butternuts to an agent at the Fresh Produce Market (FPM), where the product is sold to retailers and hawkers for R14.35/kg, reflecting a 14% value addition. After the sale, the agent deducts a 12.5% commission,

equating to R1.80 per kilogram, which results in the farmers receiving R12.55/kg after the commission is accounted for. Retailers and hawkers then emerge as primary buyers at the FPM, contributing to the overall market demand. Hawkers typically add 52% value, while retailers add 43% value to the products. The interaction between demand and supply in the market establishes an equilibrium price of R14.35/kg, which encompasses the remuneration farmers receive for their produce and the purchasing price from retailers and hawkers. However, information asymmetry remains a concern and affects various stages of the value chain.

Farmers often lack comprehensive knowledge regarding how market prices are established and what retailers or hawkers are prepared to pay for butternuts. This information asymmetry reduces their negotiating power and forces them to accept the prices offered at the Fresh Produce Market (FPM), even when prevailing market conditions may warrant a higher price. Additionally, farmers are generally unaware of the market dynamics that determine the agent's fixed commission rate of 12.5%. This commission is deducted without giving farmers insight into the complete value of the sale, further increasing their financial burden. Furthermore, farmers incur extra expenses for packaging, transportation, and marketing, none of which are covered by the agent or reflected in the prices set at the FPM. This lack of information inhibits farmers from fully grasping or negotiating the actual costs and profit margins involved, thereby constraining their overall profitability.

Retailers and hawkers have better access to market information and consumer-demand trends, allowing them to set prices that maximize their profit margins. Farmers, however, lack access to this critical information, which prevents them from capturing a fair share of the value added at these later stages in the chain. Kapari *et al*. (2023) also note that smallholder farmers lose more revenue due to higher transport and packaging costs compared to large-scale farmers, who benefit from economies of scale. This adds to the financial strain on smallholder farmers, further exacerbated by the information asymmetry they face when competing in formal markets.

Summary of Price Increases:

Farmer's Price: R12.55/kg (100% base price) → Nwanedi

Fresh Produce Market Price: R14.35/kg (14% increase from the farmer) → Hawkers

Hawker's Price: R30/kg (139% increase from the farmer) → Retailers **Retailer's Price**: R25/kg (99% increase from the farmer)

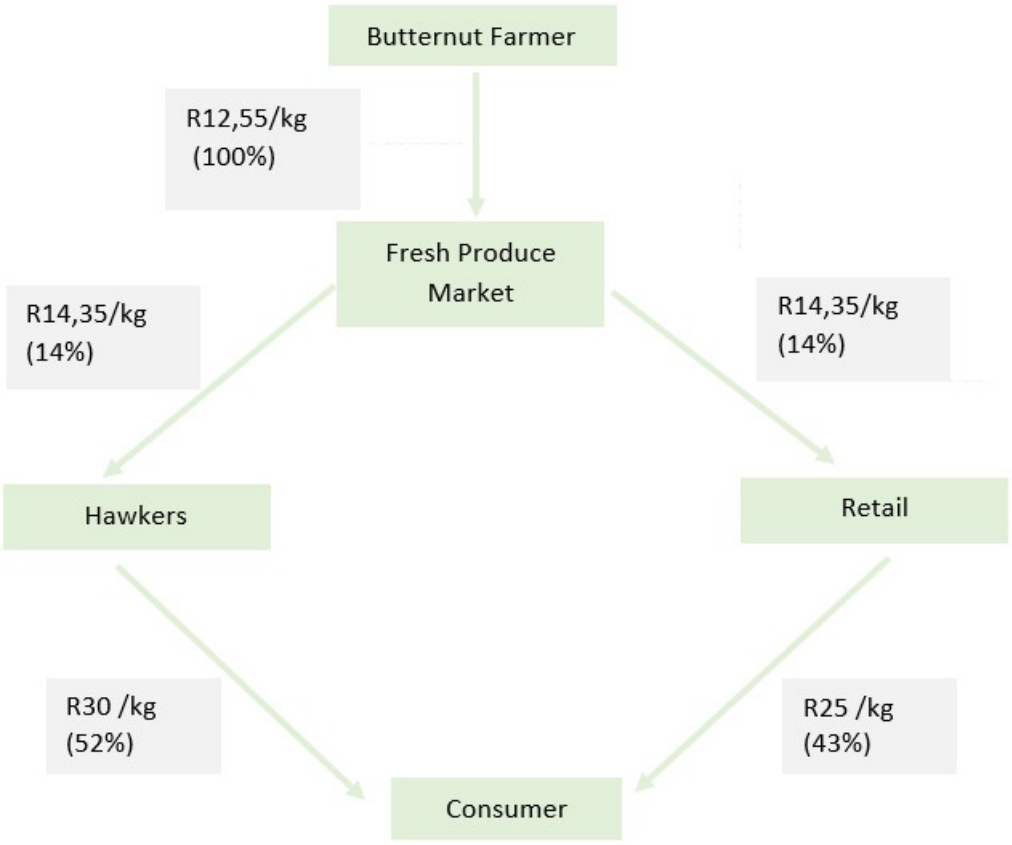


Figure 5.3: Formal Market Value Chain for Butternut

The results from the Figure 5.3 demonstrate significant price increases as butternut move through the value chain, from the farmer to the processor and finally to the retailer. These price escalations, often referred to as value addition or value capture, are typical in agricultural value chains and are driven by factors such as processing costs, transportation, market demand, and market power. The considerable increase in the price of butternuts from the farmer to the processors (1256.8%) and from the processors to the retailer (approximately 49.16%) reflects the substantial value captured by intermediaries. This phenomenon, however, is not simply a reflection of costs but is deeply rooted in information asymmetry and power imbalances within the agricultural markets (Labar, 2023). Information asymmetry occurs when one party, such as processors or retailers, has access to critical market information, such as current demand, final consumer prices, and profit margins, that the farmers lack. This gives intermediaries more control over price negotiations, allowing them to capture a disproportionate share of the value created along the chain.

5.4.2. Key Points on Information Asymmetry and Value Capture

5.4.2.1. Farmer vs Processor and Retailer

Farmers typically have limited access to real-time market information, such as the prices that processors and retailers are willing to pay or the final retail prices consumers will pay for the product. As a result, farmers are at a distinct disadvantage when negotiating prices with processors and retailers. The 1256.8% increase in the price, from farmer to processor, is not merely a reflection of processing costs but also of the information gap. Farmers may not be aware of the added value that processors derive through processing and packaging, nor the final price consumers are willing to pay. This asymmetry enables processors to capture a larger share of the value.

5.4.2.2. Impact on Farmers' Share

Due to information asymmetry, farmers receive a relatively small share of the final retail price, hence, while they perform the initial and often the most labour-intensive step of production, they do not have enough market power or access to pricing data to negotiate better prices. As a result, they are forced to accept low prices, such as R12.55/kg, even though the calculated production cost was R47.81/kg. This disparity is often exacerbated by downward pressure on farm-gate prices, driven by factors beyond farmers' control, such as seasonal fluctuations, quality standards imposed by retailers, and competition from larger-scale farms or imports (Corporate Finance Institute, 2023).

5.4.3. Market Power of Intermediaries

Processors and retailers, being more informed and often having more bargaining power, can control the prices they pay to farmers; this is especially problematic in formal markets, where the value chain is long and complex. Intermediaries add value through processing, packaging, branding, and retail distribution, which justifies some of the price increase, but their market dominance allows them to capture more value than they create. In contrast, farmers, especially smallholders, remain price-takers, with little say in the prices they receive.

5.4.4. Impact of Market Dynamics and Price Discrepancies

The discrepancy between butternut's calculated price of R47.81/kg (the theoretical price based on input costs) and the market price of R12.55/kg highlights the significant effect of market dynamics on farmers' net revenue. These dynamics, influenced by - supply and demand, seasonality, competition, and quality standards - further reduce the price farmers can negotiate. In Nwanedi, smallholder farmers, in particular, face these challenges. They may produce high-quality butternut, yet receive low prices due to market imperfections and information asymmetry that skew the distribution of value in favour of processors and retailers.

5.5. Alternate Value Chain for Butternut (Smallholders, Retailers and Consumers)

This section presents an alternative condensed version for the butternut value chain. Butternut producers are characterized by a direct transactional pathway between farmers and final consumers via the Nwanedi Agri-hub Packhouse. The value addition is illustrated in Figure 5.4.

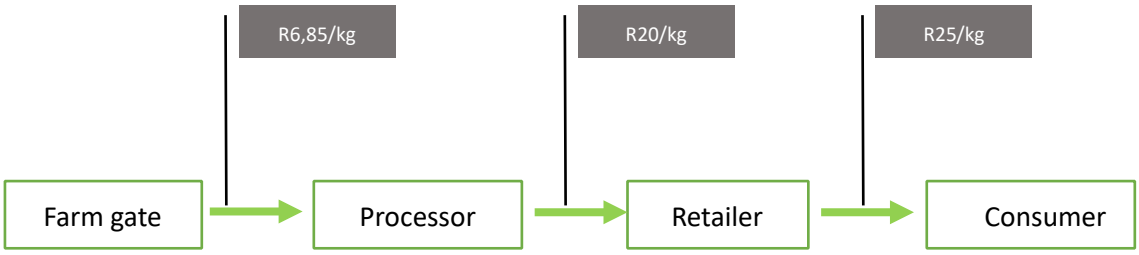


Figure 5.4: Nwanedi Agri-Hub destined Value Chain for Butternut

Figure 5.4 represents the value chain for butternut, showing the flow from the farmer through intermediaries (Fresh Produce Market, hawkers, and retailers) to the final consumer. It demonstrates the price increases at each stage and the percentage markup relative to the farmer's price. Below is a detailed explanation of each component, including the price calculations and percentage increases. The secondary butternut value chain involves farmers primarily focusing on production, after which they send their harvested produce to local retailers. At this stage, the butternuts undergo essential processing steps, such as washing, grading, packaging, and storing. Following these processes, as shown in Figure 5.4, the processed butternuts are transported to a distribution center in Polokwane. At the packhouse level, farmers receive a pre-determined price of R6.85 per kilogram for their produce. This price is set by the retailer at the beginning of the growing season, specifically for Nwanedi producers. Once the butternuts reach the distribution center, retailers sell them to final consumers at a retail price of R25 per kilogram, marking a 265% value addition. In the butternut value chain in Nwanedi, only a few key actors are involved. In the primary interaction, farmers sell their produce directly to the National Fresh Produce Market, where they interact with retailers and other buyers; the pricing mechanism at this stage is dictated by supply and demand dynamics. Retailers, in turn, charge R25 per kilogram to consumers, which represents a significant markup from the initial purchase price of R6.85/kg. Retailers gain a profit margin of R10.15 per kilogram after covering their costs, which include electricity, packaging, technology, labor, and management inputs, however, information asymmetry plays a critical role throughout this value chain. Farmers often lack access to vital market information, such as the actual prices at which retailers sell the butternuts to consumers or the true costs incurred by retailers in processing and distributing the product. This lack of information and transparency prevents farmers from negotiating better prices or capturing a more significant share of the value created along the chain.

5.5.1. Information Asymmetry at Different Stages

Farmers agree to a pre-determined price of R6.85 per kilogram for tomatoes at the start of the growing season, without access to up-to-date market information. Retailers, on the other hand, can adjust their pricing strategies, at any time, based on real-time market conditions. This asymmetry

places farmers at a disadvantage, as they are locked into lower prices even if market demand and retail prices rise during the selling season.

i) Retail Pricing

Retailers sell the butternuts at R25 per kilogram, which is significantly higher than what farmers receive. This markup is based on value addition through processing, packaging, and distribution, however, the absence of clear, accessible information regarding the final retail price contributes to the information asymmetry that leaves farmers unaware of the true value their produce commands in the consumer market.

ii) Market Disparities

The discrepancy between the theoretical price tomato farmers should charge (R47.81/kg) and the price they actually receive (R6.85/kg) underscores the market disparities that affect their returns. These disparities stem from power imbalances and the unequal distribution of information between farmers and retailers, supporting the findings of Ndlovu and Masuku (2021), who argue that farmers are often underpaid, despite their ability to charge higher prices under fairer market conditions.

5.5.2. Impact on Smallholder Farmers

As pointed out by Abokyi *et al*. (2020), smallholder farmers in developing countries often face income instability due to unpredictable farm prices, exacerbated by the lack of price stabilization mechanisms and market support systems. The price inelasticity of agricultural produce, coupled with market challenges, such as - incomplete market information, poor infrastructure, and inadequate access to markets - resulting in output price volatility, which negatively impacts farmers' income. While value addition in the butternut value chain results in substantial profit margins for intermediaries, information asymmetry leaves farmers at a significant disadvantage. Without access to market data and transparency in pricing, farmers in Nwanedi, like many smallholder farmers in developing markets, continue to face challenges in capturing a fair share of the value their produce generates. Addressing these asymmetries through policy reforms, better market infrastructure, and technological innovations, is key to improving the livelihoods of smallholder farmers and ensuring more equitable value distribution.

5.5. Chapter Summary

An analysis of the tomato and butternut value chains reveals significant price increases as the commodities move from farmers to retailers, illustrating the substantial value captured by intermediaries at various stages. These price escalations are driven by factors, such as processing, transportation, and market forces, and they highlight the difficulties farmers face in obtaining a fair share of the final retail price. The information asymmetry in these chains, where intermediaries and retailers hold more

knowledge about market prices, demand, and consumer trends, places farmers at a distinct disadvantage. This lack of access to real-time market information limits the ability of smallholder farmers to fully capitalize on their produce and negotiate better prices. In Nwanedi, smallholder farmers experience significant market disparities in both the tomato and butternut value chains, hence, despite a substantial rise in the retail price of butternuts and tomatoes during the value addition process, farmers do not experience a proportional financial gain. Butternuts, for example, undergo multiple value adding, such as through processing, packaging, and transporting, yet farmers receive only a fraction of the final retail price due to predetermined pricing mechanisms and the uneven power allocation in the value chain. Retailers, armed with more market information and greater bargaining power, are able to capture a disproportionate share of the profits.

This imbalance underscores the broader challenges faced by small-scale farmers, such as volatile price changes, market inefficiencies, and inadequate infrastructure. The significant disparity between the calculated potential earnings and the actual market prices reveals the profound influence of information asymmetry. Farmers, lacking access to crucial market data, such as current prices and demand trends, are unable to negotiate prices that reflect the true value of their produce. This imbalance of information allows intermediaries and retailers to dictate prices, leaving farmers with reduced incomes and limiting their ability to fully benefit from their agricultural output. The tomato and butternut value chains illustrate the significant challenges smallholder farmers face due to information asymmetry, power imbalances, and market inefficiencies. Farmers are often left with low earnings, unable to benefit from the value their produce gains as it moves through the supply chain. Strategic initiatives such as - improving market access, increasing bargaining power, providing real-time market information, and stabilizing prices - are essential to ensuring that farmers receive equitable compensation for their efforts and can sustain long-term investments, in their agricultural activities. By addressing these market disparities, smallholder farmers will be better positioned to maximize their income and contribute to the growth of the agricultural sector.

CHAPTER 6

PROFITABILITY OF SMALLHOLDER FARMERS' BUTTERNUT AND TOMATO VALUE CHAINS

6.1. Introduction

In the Nwanedi region, small-scale farmers cultivating tomatoes and butternuts largely depend on traditional farming techniques, characterized by the use of basic irrigation systems and manual watering methods. These methods have been used for generations; however, they may not always maximize crop yields or resource efficiency (Pankowska, 2019). To assess and improve productivity among these smallholder farmers, measuring profitability and Return on Investment (ROI) is essential (Bais, 2023). These variables serve as key indicators of the financial efficiency of farming operations by comparing the total costs (both variable and fixed) with the revenue generated from the sale of tomatoes and butternuts. First, profitability measures the financial success of the farming operations by calculating the difference between total revenue and total costs (Wolf & Karszes, 2023) - it is a direct indicator of whether the farm is making a profit or a loss. This calculation helps identify how efficiently resources are being used, relative to the income generated from the crops. Second, Return on Investment (ROI) is a critical metric that calculates the percentage return on the investments made in farming activities (Feukeng, et al., 2023). The result is expressed as ROI equated to net profit divided by total investment multiplied by 100, thus, ROI shows how much profit a farmer gains relative to the amount spent on inputs (for example, seeds, fertilizers, labour) and infrastructure (for example, irrigation systems). These variables do not just indicate financial performance but also provide valuable insights for strategic decision-making (Wolf & Karszes, 2023). By regularly analysing profitability and ROI, farmers can identify areas of inefficiency, such as high input costs, poor crop management, or limited market access. This understanding allows farmers to implement targeted improvements, such as adopting modern irrigation technologies, enhancing soil fertility management, or improving post-harvest handling processes to minimize losses and increase crop value.

Measuring profitability and ROI, therefore, enables small-scale farmers to optimize their operations, ensuring that they make informed decisions that can boost productivity, reduce costs, and improve overall sustainability. Moreover, by focusing on these performance indicators, farmers can make informed decisions about resource allocation, ensuring that their investments yield the highest possible returns; investing in improved irrigation systems or crop protection measures, for instance, could lead to significant increases in yield, thereby boosting overall profitability. Additionally, by tracking ROI over time, farmers can gauge the effectiveness of these interventions, adjust their strategies as needed to sustain or enhance productivity. Ultimately, the consistent assessment of profitability and ROI enables tomato and butternut growers in Nwanedi to enhance their operational efficiency and long-term sustainability. By embracing a more analytical approach to their farming practices, these smallholder

farmers can improve their economic resilience, better withstand market fluctuations, and contribute more significantly to the local economy (Brixiova et al., 2020). As such, the integration of modern farming techniques and the strategic use of financial metrics are essential for driving growth and ensuring the continued success of small-scale agriculture in the region.

6.2: Research Methods

Profitability measures the financial performance of tomato and butternut cultivation by assessing the difference between revenue and costs. The formula used for profitability is:

$$\text{Profitability (\%)} = \frac{(\text{Revenue} - \text{Total Costs})}{\text{Total Costs}} \text{ X } 100$$

- Revenue: The total income generated from selling tomatoes and butternuts.
- Total Costs: The sum of all costs incurred in tomato and butternut cultivation, including production costs, labour, inputs, overheads, and any other expenses.

i. Return on Investment (ROI)

ROI quantifies the profitability of an investment relative to its cost. It indicates the efficiency of capital utilization and measures the return gained from the investment, compared to its initial cost.

The formula used for ROI is:

Net Profit is the amount left after deducting all the expenses from the total revenue (or sales). The formula is:

Net Profit = Total Revenue − Total Expenses

where:

Total Revenue is the total income generated from sales.

Total Expenses include costs such as operating expenses, taxes, interest, and other costs.

Once Net Profit has been calculated, the Return on Investment (ROI) may be calculate using the following formula:

$$\text{ROI (\%)} = \left(\frac{\text{Net Profit}}{\text{Total Investment}} \right) \text{ X } 100$$

- Net Profit: The total profit earned from tomato cultivation after deducting all costs, including initial investment.
- Total Investment: The total capital invested in cultivation, including land, equipment, seeds, labour, and other expenses.

6.3. Results and Discussions

This section presents the results on profitability of tomatoes and butternuts smallholder farming. To clearly comprehend farmers profitability, total revenue per hectare is calculated first; afterwards, the distribution of profitability for tomato and butternut smallholder farming in Nwanedi is then derived. Four quartiles are considered (first quartile -1 to 25; 2nd quartile - 26 to 50; 3rd quartile - 51 to 75 and lastly 4th quartile - 76 to 100). For this process, Profitability Interval and return on investments (ROI) for farmers are then categorised using 4 quartiles. The following sub-section presents the profitability calculations.

6.3.1. Profitability of Smallholder Farmers Producing Tomatoes and Butternuts

To determine profitability, cost per farmer and revenue per farmer were determined.

6.3.1.1. Total Revenue and Total Cost per Farmer

Step 1: Total Revenue per Farmer

TR per farmer = $\frac{Total\ Revenue}{N} = \frac{R56{,}406{,}606}{150}$ = R376, 044.04

Total cost per farmer

TR per farmer = $\frac{Total\ Cost}{N} = \frac{R41{,}330{,}679}{150}$ = R275,537.86

Step 2: Profitability Calculations

Profitability (%) is calculated as:

Profitability (%) = $\left(\frac{Revenue - Total\ Cost}{Total\ Cost}\right)$ x 100

Substituting values:

Profitability (%) = $\left(\frac{R376{,}004.04 - 275{,}537.86}{275{,}537.86}\right)$ x 100 = 36,97%

Step 3: Return on Investment (ROI) Calculation

ROI (%) is calculated using the formula:

ROI (%) = $\left(\frac{Net\ profit}{Total\ Investment}\right)$ x 100

First, calculate Net Profit:

Net Profit = R376,044.04 – R274,537.86 = R100,506.18

Now, substitute for net profit in the ROI formula:

ROI (%) =$\left(\frac{100,506.18}{246,644}\right)$ x 100 = 40.75%

Step 4: Profitability Per Hectare

Since each farmer has 5.19 hectares, we need to calculate the profit per hectare:

- Profit per farmer:

Profit per farmer = R376,044.04 − R275,537.86 = R100,506.18

Profit per hectare:

Profit per hectare = $\frac{Profit\ per\ farmer}{5.19} = \frac{R100,506.18}{5.19}$ = R19,373.49

Thus, profit per hectare is **R19,373.49**.

Final Summary:

Profitability (%) = 36.97%

ROI (%) = 40.75%

Profit per hectare = **R19,373.49**

NB: Given the availability of data at farm level, the researcher was able to calculate ROI per hectare for each farmer, however, the researcher could not calculate ROI for other segments such as bakki traders, hawkers and retailers. Data, such as costs incurred, was inaccessible from the above players in the value chain; ROI for farmers is commented on in the following section. Table 6.1 presents the profitability distribution for smallholder tomato farmers in Nwanedi.

Table 6.1: Distribution of profitability for smallholder tomato farming in Nwanedi

Profitability Interval	No. of Smallholder farmers	%		ROI Interval	No. of Smallholder farmers	%
< 0	30	**20**		**<0**	**28**	**19**
1 to 25	27	18		1 to 25	**33**	**22**
26 to 50	25	16		26 to 50	29	19
51 to 75	28	18		51 to 75	24	16
76 to 100	40	26		76 to 100	36	26
Profitable = 36,97%				**ROI = 40, 75%**		

6.3. Profitability of Farmers

To assess the profitability of smallholders, the researcher calculated the profitability index, which was found to be 36.97% and based on this index, profitability intervals were established, as shown above.

i. The first category comprises tomato farmers who incurred a loss (less than 0% profitability) and according to Table 6.1, 20% of smallholder tomato farmers fall into this category. This indicates that a significant portion of farmers experienced losses or negative profitability, suggesting they did not efficiently utilize available resources. Contributing factors could include - poor crop management practices, adverse weather conditions, market fluctuations, or limited access to resources and inputs.

ii. The second category, with profitability between 1 and 25%, shows that 18% of smallholder farmers fall within this range, indicating a modest level of profitability. This means that, although these farmers are making some profits, their margins remain relatively low, hinting at challenges in - cost management, market competitiveness, or yield optimization.

iii. The third category, with profitability between 26 and 50%, shows that 16% of smallholder tomato farmers fall into this category, reflecting a moderate level of profitability. These farmers are managing their operations more efficiently, achieving higher yields, and/or controlling costs effectively to generate profits above the 36.97% profitability index.

iv. The next category, with profitability between 51 and 75%, comprise 18% of smallholder farmers, reflecting a relatively high level of profitability. These farmers are - employing effective management practices, optimizing production processes, and accessing lucrative market opportunities - leading to significant profits.

v. Finally, the highest profitability interval, between 76 and 100%, consists of 26% of smallholder farmers. This group have demonstrated a very high level of profitability and operational efficiency, excelling in areas such as - crop management, marketing strategies, value addition, and cost control - resulting in substantial profits.

This analysis highlights that over 50% of smallholder farmers are performing above the 36.97% profitability index, showcasing the crucial role that smallholder farms play in South Africa's agricultural landscape. The results regarding the profitability of smallholder tomato farmers correspond with existing literature on smallholder agriculture, which frequently demonstrates differing profitability levels stemming from - diverse management techniques, resource availability, and market circumstances. Research on smallholder farming systems often highlights how resource constraints affect efficiency and profitability, especially in developing areas. For instance, studies by Feukeng, et al., (2023) and Dhillon and Moncur (2023) concluded that smallholders with restricted access to credit, poor seed types, and lacking extension services, typically face challenges with production expenses and attaining

profitable yields; these factors frequently land them in the low or loss-generating groups, as illustrated by the 20% of farmers experiencing losses in this context. This significant number of farmers showing low or negative profitability in this study also aligns with the findings by Feukeng, et al., (2023) indicating that farming services focusing on resource access and training, may be advantageous.

The moderate profits seen in the second and third intervals (1–25% and 26–50%) indicate the limited, yet strong, characteristics of smallholder farms, as outlined by Mabhaudhi, et al., (2018) in his study entitled - *Prospects for Improving Smallholder Farming* - for rural agriculture. Smallholder farmers frequently use adaptive strategies to maintain profitability even with scarce resources and uncertain markets, although their profits are still modest. Recent research, including that of Hong, et al., (2023) indicates that the low-to-moderate profitability of smallholders can be linked to difficulties in, market access, securing fair prices, and ensuring crop quality. The farmers within these profitability ranges are probably navigating these limitations, seeking aspects where - advancements in infrastructure, market accessibility, and collective selling - might boost their profitability.

The high-profit range (51–100% profitability) also reflect the conclusions of recent studies that noted the significance of - improved farming methods, market connections, and purposeful resource management - among thriving smallholder farmers. Studies conducted by Dessale, (2019), Muzekenyi *et al.* (2022) and Rivaldy and Pratama (2023) suggest that smallholder farmers - with access to superior inputs, the ability to utilize technology, and enhanced supply chain links - generally attain greater profitability. This implies that the current study, with more than 50% of farmers exceeding the average profitability index reveals the possibility for smallholder farms to succeed in South Africa's agricultural sector, when they are sufficiently supported. These results concur with Muzekenyi *et al.* (2022) on the idea that - focused investments in technology implementation, education, and market incorporation - can enhance smallholder profitability, bolstering their contribution to national food security and rural growth.

In line with the above results, it stands to reason that despite various challenges, small-scale farmers have immense potential to contribute positively to the country's economy while also promoting regenerative and sustainable agricultural practices (Dhillon & Moncur, 2023). The findings illustrate the diversity of profitability levels among smallholder tomato farmers, with a significant proportion experiencing positive profitability, although a notable segment faces challenges, including losses or marginal profitability. Understanding the factors driving these profitability variations can help shape targeted interventions and support systems to enhance the economic sustainability and resilience of smallholder-farming communities

6.4. Return on Investments for Farmers

The data displayed in Table 6.1 demonstrates the allocation of Return on Investment (ROI) among small-scale farmers. The overall return on investment (ROI) index is documented as 40.97%. ROI, or

return on investment, quantifies the efficiency with which smallholder farmers produce profits from their capital, relative to the initial investment cost throughout a certain timeframe. The results classify ROI into intervals according to percentage ranges. Approximately 19% of smallholder farmers are located within the interval of <0. Within the range of 1 to 25%, around 22% of smallholder farmers are located, indicating a moderate level of return on investment (ROI); these farmers do generate some profits, although the profit margins are expected to be low, indicating possible difficulties in maximizing production efficiency. Within the 26 to 50% range, 19% of smallholder farmers are classified in this bracket, suggesting a satisfactory return on investment, however, that is lower than the general index. These farmers can anticipate favourable returns on their investments, since they are demonstrating some efficient management methods. Within the range of 51 to 75%, a total of 16% of smallholder farmers are positioned, suggesting a highly-elevated degree of return on investment (ROI). These farmers are highly skilled in several areas of farming, such as value addition and cost efficiency, which is leading to significant profits. Out of all the smallholder farmers, the largest percentage, 26%, falls within the interval of 76 to 100% - a very high level of return on investment (ROI).

These noted ROI distribution rates among small-scale farmers correspond with current research regarding the varied financial outcomes in smallholder farming systems. Research conducted by Bais and Bahadur (2023) along with Dhillon and Moncur (2023) concur that variability in ROI is typical in smallholder agriculture, primarily shaped by diverse factors such as - resource availability, input expenses, and market access. As indicated in Table 6.2, 19% of smallholders exhibit a negative ROI. The findings are in line with those of Feukeng et al. (2023), who point out that factors like - elevated input expenses, inadequate infrastructure, and weak bargaining power - can adversely affect the profitability of smallholders. Smallholder farmers frequently encounter barriers that hinder their capacity to recoup their initial investment, indicating a necessity for policy measures that enhance resource accessibility and reduce input costs.

The moderate ROI noted among 22% of smallholder farmers (1–25% ROI) aligns with the conclusions of Hong et al. (2023), who assert that smallholders with limited resources frequently find it difficult to attain significant profitability, regardless of their diligent cost and production management efforts. This group shows slight profitability, indicating that, although these farmers might be using sound management practices, they are still hindered by restricted capital and market access. The presence of these modest returns in smallholder systems indicates the potential positive effects of focused support initiatives that could improve yield optimization and offer access to stable, profitable markets, as suggested by Feukeng et al. (2023).

The category with higher ROI (51–100%), which comprise 42% of farmers, testifies to the necessity of efficient management and innovation in obtaining better financial results, according to research by Rather et al. (2023). These results are evidence that smallholders who adopt effective cost management, value-enhancing methods, and strategic market-connections can attain substantial ROI,

potentially surpassing the average index of 40.97%. This trend reinforces the notion that the profitability of smallholders can be significantly boosted through - better farming practices, access to superior inputs, and improved market information - aligning with the wider literature on the evolution of smallholder farming into a sustainable business model. These successful smallholder farmers demonstrate the capacity for small-scale agriculture to flourish when equipped with the appropriate skills, resources, and market access.

Ultimately, smallholder farmers in Nwanedi can be said to be demonstrating extraordinary yields, highlighting exceptional productivity and significant profitability in their agricultural endeavours. Remarkably, a substantial majority of 60% of the farmers, surpass the 40.97% threshold for return on investment (ROI), indicating a wide range of ROI levels among smallholder farmers. This is an indication of the widespread occurrence of favourable investment returns within this agricultural sector. These findings contrast with the conclusions of Langyintuo (2020), who suggested that inefficiencies among smallholder farmers are a contributing factor to a poorer return on investment (ROI). In addition, the current findings challenge those of Kamara et al. (2019), who proposed that more than 60% of smallholder farmers are affected by inefficiency, citing multiple issues that impede agricultural output in Africa. On the other hand, these findings suggest that small-scale farmers in Nwanedi possess a high level of skill in effectively utilizing the resources that are accessible to them. Their capacity to attain substantial profits implies efficient utilization of resources and implementation of sustainable agriculture methods. The ability to bounce back from obstacles and adjust to new circumstances is essential for reducing difficulties and promoting economic expansion in the agricultural industry.

6.5. Chapter Summary

The analysis of smallholder farmers involved in the cultivation of both butternut and tomatoes reveals a wide range of experiences and difficulties encountered in farming this produce. For small-scale farmers growing butternut squash, the examination of the value chain shows different routes, where some farmers sell directly to shops, while others choose to participate in centralized markets. The profitability of these smallholder farmers varies, with some achieving large returns through direct sales, while others face challenges in navigating market dynamics to earn respectable profits. Moreover, the participation of several stakeholders throughout the value chain underscores the interconnectedness and extensive negotiation processes that are inherent in agricultural markets. Tomato smallholder farmers encounter varying levels of profitability and return on investment, which are influenced by factors such as crop management, market access, and resource usage. While several farmers attain substantial profitability by implementing efficient production techniques and engaging in strategic market activities, others face difficulties such as depressed market pricing, high input expenses, and restricted access to value-added prospects. The results, thus, highlight the significance of customized assistance measures and interventions to tackle the varied requirements and limitations encountered by small-scale farmers in

the butternut and tomato industries. To build economic resilience and sustainability in agricultural communities, it is necessary also to - improve market connections, grant access to resources and technology, encourage sustainable farming methods among small-scale farmers, and reinforce farmer cooperatives and networks. Smallholder farmers can improve their lives and contribute to rural economic development by tackling these issues and taking advantage of chances to add value and integrate into the market.

The examination of Return on Investment (ROI) among smallholder farmers in Nwanedi uncovers a range of efficiency levels in the exploitation of resources and techniques for managing them. The results illustrate that while certain farmers attain moderate returns, others succeed in optimizing production procedures, resulting in significant income. The farmers are distributed according to the various returns on investment (ROI) intervals, which demonstrates the diversity within the agricultural community. A substantial number of farmers are achieving favourable returns on their investments; hence, these findings contradict prior claims of prevalent inefficiency among small-scale farmers in the area. In contrast to previous research indicating inefficiency, the current results demonstrate that a significant proportion of the farmers effectively utilize the resources at their disposal to reach noteworthy levels of return on investment (ROI). This highlights the significance of analysing the setting and implementing customized interventions to facilitate agricultural development. In the future, policymakers and stakeholders should take into account these subtle and detailed findings when creating policies to improve the productivity and livelihoods of smallholder farmers. Implementing focused assistance-initiatives that target the unique obstacles encountered by various sectors within the farming community can foster long-term agricultural expansion and promote economic progress in the area.

CHAPTER 7
SYNTHESES OF CHAPTERS

7.1. Introduction

This section encapsulates the concluding remarks and recommendations derived from the study. The primary objectives of the research were to delineate the value chains associated with tomato and butternut crops within Nwanedi Agri-hub. Subsequently, the study aimed to scrutinize the processes of value creation and information dissemination concerning these crops in Nwanedi Agri-hub, ultimately culminating in an assessment of the efficiency of smallholder farmers operating within this agricultural context. The following section presents the findings per each chapter, however Chapters 4, 5 and 6 encapsulated the conclusion drawn from the study and presents recommendations concerning information asymmetry and the profitability of tomato and butternut value chains. Additionally, empirical results extracted from relevant literature are presented in the subsequent sections, further enriching the discourse.

7.1.1. Characterisation of the Participants

The examination of the value chain for tomatoes and butternuts in the Nwanedi region uncovers the participation of several stakeholders - smallholder farmers, processors, distributors, retailers, and customers. Agro-dealers provide a crucial function by providing critical agricultural inputs, such as seeds, pesticides, and machinery, while farmers also depend on guidance from groups like the Nwanedi Cooperative and government extension programs. The Nwanedi Agri-hub functions as a central point, offering market intelligence, mechanization services, and capacity-building assistance to improve farming productivity. Local labourers play a substantial role in farming activities, while smallholder farmers are organized into associations that promote their interests and enable the improvement of their skills.

The local market plays a vital role as an essential conduit for smallholder farmers, enabling them to sell their agricultural products to street vendors and consumers. Processors enhance the tomatoes by preserving, crushing them, and distributing sauces and pastes, which are subsequently sold to shops, such as Spar, Shoprite, Pick & Pay, and Checkers. These retailers increase the worth of the produce by using tailored packaging that aligns with consumer preferences and adheres to food safety rules. The retail prices of tomatoes and butternuts are determined by the total value added, at every stage of the supply chain. The results displayed the notable existence of small-scale commercial farmers in the Nwanedi Agri-hub, with a growing involvement of women, indicating a change from the historically male dominated rural farming industry. The majority of these farmers, who are involved in full-time mixed farming throughout the year, depend on agriculture as their main source of income, although, the report

highlights a significant deficiency in agribusiness education among these farmers, which hampers their efficiency. Furthermore, the matter of land ownership remains unsolved, as the majority of farmers work on communal or freehold land without guaranteed tenure. The absence of land stability impedes farmers' ability to make long-term investments and advancements in agriculture. Furthermore, the bulk of these farmers predominantly sell their agricultural products in nearby marketplaces, with restricted their opportunities to access national and global markets, which have the potential to provide better financial gains and increased visibility.

According to these findings, the paper recommends that the government should enhance its activities to offer multifaceted support to small-scale commercial agriculture in rural areas. This involves providing education in the field of business administration and marketing strategies to enhance the productivity of farmers. There is also a need for incentives to attract the participation of young individuals in agriculture, which might effectively reduce unemployment rates in rural areas. It is crucial to also take into account the issue of land rights, to ensure that farmers have both access to fertile land and secure land ownership - this would foster sustainable agricultural development. In order to ensure the long-term sustainability and growth of small-scale commercial agriculture in the area, it is crucial for the government to develop a comprehensive strategy to identify efficient farmers and provide customized support to those experiencing challenges.

7.1.2. Value-creation and information-sharing processes of butternut and tomato crops' farmers

The examination of the tomato and butternut value chains in Nwanedi reveals significant price escalations as these agricultural products move from farmers to merchants, with middlemen capturing a substantial share of the value. Price increases driven by factors, such as - processing, transportation, and market dynamics - stress the challenges small-scale farmers face in securing a fair share of the final retail price. The disparities between farm-gate and market prices underscore the unequal distribution of power and information asymmetry within the value chain, putting farmers at a disadvantage and reducing their overall income.

The concept of information asymmetry plays a crucial role in this imbalance, as smallholder farmers often lack access to critical market information that intermediaries and retailers possess. This unequal access to knowledge about pricing, market trends, and consumer demands limits the farmers' ability to make informed decisions and weakens their bargaining position. As a result, farmers are often unaware of the actual market prices for their produce, allowing intermediaries to exploit this information gap, resulting in farmers receiving a lower share of the profits. In the butternut value chain, value addition significantly increases prices from production to retail, however, producers do not experience a corresponding rise in income. Retailers capture a significant portion of the profits, driven by fixed-pricing mechanisms that further reflect the power imbalances and inequities in the value chain. This unequal

distribution of profits, coupled with challenges such as fluctuating prices and inadequate infrastructure, disrupts farmers' earnings and limits their ability to sustain their businesses.

Addressing these challenges requires strategic measures; for example, establishing cooperatives or farmer associations can improve farmers' negotiation power and ensure a more equitable distribution of value. Providing timely market information is crucial to empowering farmers and mitigating the effects of information asymmetry. Additionally - investments in infrastructure to reduce post-harvest losses; implementing price stabilization mechanisms to protect against market volatility and facilitating direct market access to bypass intermediaries - are essential steps that can be taken. These efforts would enable farmers to retain a larger portion of the retail price and promote long-term sustainability in agriculture.

7.1.3. Profitability of Smallholder Farmers

The examination of small-scale farmers engaged in the cultivation of butternut and tomatoes in Nwanedi reveals a broad range of experiences and challenges in these agricultural sectors. Smallholder farmers experience varying levels of profitability across the value chain. In Chapter 6, the findings indicate that 80% of smallholder farmers possess a favourable profitability index, with 44% reaching elevated profitability levels (51-100% range). A mere 20% of farmers experienced losses, revealing a predominantly profitable smallholder farming sector. This shows that smallholder farmers face differing levels of profitability, influenced by diverse factors, such as crop management practices, market access, and resource utilization. While some farmers manage to generate substantial profits through efficient techniques, others encounter difficulties due to low prices, high input costs, and limited opportunities for value addition. A key factor affecting both butternut and tomato producers is information asymmetry. Many small-scale farmers lack access to vital market information, including pricing trends, demand forecasts, and input cost efficiencies. The effect of this disparity in knowledge, on intermediaries and retailers, shows that it leaves farmers more vulnerable to unfavourable market conditions and diminishes their ability to negotiate fair prices. As a result, those with limited market insights may sell their produce at lower rates, missing opportunities to maximize profitability.

The analysis of Return on Investment (ROI) among these farmers also highlights a wide spectrum of efficiency levels. The calculations show that 44% of the farmers reached moderate profits of R19,373.49 per hectare due to resource constraints and limited market access, while others strategically optimize their production systems to realize more significant profitability. This variability contradicts earlier generalizations of inefficiency in small-scale farming and underscores the relevance of assessing each farmer’s circumstances individually.

To improve the economic resilience and sustainability of these farmers, it is essential to address information asymmetry and other challenges. Enhancing market linkages, improving access to

resources and technologies, promoting sustainable agricultural practices, and fostering farmer cooperatives can empower farmers to better navigate the value chain and boost their profitability. Policymakers and stakeholders should develop targeted strategies that reflect these nuanced findings, offering tailored support programs to enhance productivity, market competitiveness, and the livelihoods of smallholder farmers.

7.2. Results of chapters' summaries

Chapter 4: Characterisation of Smallholder farmers and information asymmetry

This section offers an in-depth profile of smallholder farmers within the Nwanedi Agri-hub, highlighting demographic and socio-economic traits such as gender, education level, and farm dimensions. The results indicate that a notable portion of participants are female, as they are increasingly assuming farming responsibilities due to the migration of men. Most farmers depend significantly on agriculture for their main income, but issues such as insufficient agribusiness training and unstable land tenure continue to be common challenges. These limitations impact the farmers' output and their ability to reach broader markets.

Chapter 5: Comparing the Value Creation and Information-Sharing Process of Butternut and Tomato Crops' Farmers

The processes of value-creation and information-sharing among butternut and tomato farmers were examined, bringing out the distinctions in value-addition and market dynamics between formal and informal markets. Farmers encounter limitations because of information asymmetry, especially when intermediaries hold market insights, obstructing farmers from maximizing prices and income. This section reveals that better market access and direct selling opportunities could boost farmers' profits, since at present, a significant portion of the added value is taken by middlemen instead of the farmers.

Chapter 6: The Profitability of Smallholder Farmers in the Value Chain (Butternut and Tomato)

The financial assessment of smallholder tomato and butternut farmers reveals different degrees of monetary success, with 60% realizing a return on investment exceeding the average of 40.97%. Certain farmers are skilled at optimizing resources and managing costs, although others struggle with issues such as elevated input expenses and restricted market access, which affects their profitability. The results underscore the significance of focused strategies to improve profitability via resource efficiency, use of contemporary agricultural methods, and entry into value-added markets.

7.3. Recommendations

Based on the findings regarding smallholder farmers, several recommendations can be proposed to enhance information sharing, optimize value chains, and improve profitability within the agricultural sector.

i. Strengthening Market Linkages

The agricultural sector can facilitate the establishment of direct market linkages between smallholder farmers and end consumers or value-added processors. This could involve initiatives, such as the formation of farmer-producer organizations, contract farming agreements, or farmer markets. By reducing the role of intermediaries and addressing information asymmetry, farmers can gain access to critical market information regarding pricing, demand trends, and consumer preferences. Strengthening direct market connections - will help reduce reliance on intermediaries, minimize value chain inefficiencies, and ensure that farmers receive fair prices for their produce, thus, improving their overall profitability.

ii. Capacity Building and Training Programs

Support groups can implement training programs aimed at equipping smallholder farmers with skills and knowledge in efficient agricultural practices, financial management, and market access strategies. Addressing information asymmetry should be a key component of these programs as these will ensure that farmers have access to real-time market data, price trends, and supply chain information. By closing this knowledge gap, farmers - can better navigate market dynamics, optimize resource utilization, make informed decisions, and improve profitability.

iii. Investment in Infrastructure and Technology

Promoting investment in agricultural infrastructure and technology can enhance productivity and improve market access. This should include - the development of cold storage facilities, transportation networks, and access to information and communication technologies (ICTs) that provide up-to-date market information. By leveraging technology to reduce information asymmetry, smallholder farmers can gain timely access to market trends, improve their decision-making, and become more competitive in the value chain.

iv. Profitability and Pricing Strategies

The study suggests fostering inclusive rural development by recognizing small-scale producers as vital participants in agricultural policy creation, allowing them to obtain financial resources and improve production via cooperatives. Also essential are, establishing price support systems, concentrating on minimizing information asymmetry to guarantee that farmers have relevant current market knowledge that safeguards them from income reduction and price fluctuations, hence, increase their profitability.

These systems can protect farmers from volatile market situations, offer enhanced price stability, and ultimately increase earnings for small-scale producers.

v. **Policy Support and Institutional Development**

There should be advocates for policies and institutional frameworks that prioritize the interests of smallholder farmers and address market distortions, information asymmetry, and inequalities. Policies, such as price stabilization mechanisms, fair-trade regulations, and market-transparency initiatives can empower smallholders by providing them with the necessary information to compete on equal footing with other market actors.

7.3. Areas for future Research

After analysing smallholder farmers in the butternut and tomato sectors in Nwanedi, various areas for further research became apparent. Research can be undertaken in the smallholder agricultural sector aimed at improving market access and optimizing value chains through the exploration of direct-to-consumer models and cooperative marketing. This will empower farmers and decrease their reliance on intermediaries. In addition, research should examine the variables that impact the consumption and effectiveness of resources, with the goal of identifying optimal methods for sustainable agriculture and resource allocation. It is essential to evaluate the efficacy of customized support mechanisms, such as technological tools, financial services, and training programs in enhancing productivity and profitability. Research should additionally investigate - potential value-added prospects in butternut and tomato cultivation; sustainable farming methods to improve long-term productivity and resilience, and gender dynamics to tackle the distinct obstacles encountered by female farmers. It is equally crucial to do research on the influence of land tenure on agricultural productivity in order to provide valuable insights for the development of policies that ensure land rights and promote long-term investments. These research topics will offer vital insights to bolster more efficient policies and initiatives for sustainable agricultural growth, particularly, for the smallholder farmers.

REFERENCES

Abdul-Rahaman, A. and Abduali, A., 2018. Do farmer groups impact on farm yield and Profitability of smallholder farmers? Evidence from rice farmers in northern Ghana. *Journal of Food Policy,* 81(2018), pp. 95-105.

Ahmed, B., Jema, H. and Geta, E., 2013. Analysis of Farm Households' Technical. *American Journal of Agriculture and Environment.* 13 (12), p1615-1623.

Agyekumhene, C., de Vries, J.R., Paassen, A.V., Schut, M. and MacNaghten, P.,2020. Making smallholder value chain partnerships inclusive: Exploring digital farm monitoring through farmer friendly smartphone platforms. *Sustainability,* 12(11), p.4580.

Ali, Z. and Bhaskar, B., 2016. Basic statistical tools in research and data analysis. *Indian Journal of Anaesthesia,* 60(9), pp. 662-669.

Alshenqeeti, H., 2014. Interviewing as a Data Collection Method: A Critical Review. *Journal of English Linguistics Research*, 3(1), pp. 39-46

Anastasiadis, F., Apostolidou, I. and Michailidis, A., 2020. Mapping sustainable tomato supply chain in Greece: A framework for research. *Foods,* 9(5), p.539.

Anteneh, A. and Asrat, D., 2020. Wheat production and marketing in Ethiopia: Review study. Cogent Food & Agriculture, 6(1), p.1778893. holder_Farmers_The_Case_of_Girawa_District_Ethiopia [Accessed 5 November 2019].

Anriquez, G., 2017. Rural development and poverty reduction: is agriculture still the key. *Journal of Agriculture and Development Economics,* 4(1), pp. 5-46.

Atinkut Asmare, B., Freyer, B. and Bingen, J., 2022. Women in agriculture: pathways of pesticide exposure, potential health risks and vulnerability in sub-Saharan Africa. *Environmental Sciences Europe,* 34(1), p.89.

Baihaqi, I. and Sohal, A., 2013. The impact of information sharing in supply chains on organisational performance. *Journal of production planning and control,* 9(8), pp. 743-758.

Bais, P. and Bahadur, P.S., 2023. Agriculture in Indian Economy and Contribution of Science and Technology. *Asian Journal of Applied Science and Technology* (AJAST), 7(1), pp.167-176.

Berman, E., 2017. An Exploratory Sequential Mixed Methods Approach to An Exploratory Sequential

Mixed Methods Approach to Understanding Researchers' Data Management Practices at UVM: Understanding Researchers' Data Management Practices at UVM. *Journal of eScience Librarianship*, 6(1), pp. 1-25.

Bisht, I.S., Rana, J.C. and Pal Ahlawat, S., 2020. The future of smallholder farming in India: Some sustainability considerations. *Sustainability,* 12(9), p.3751.

Booth, A., 2018. *Southeast Asian Agricultural Growth: 1930–2010.* 2rd ed. Cham: Palgrave Macmillan

Brixiová, Z., Kangoye, T. and Tregenna, F., 2020. Enterprising women in Southern Africa: When does land ownership matter? *Journal of Family and Economic Issues,* 41(1), pp.37-51.

Busse, C., Schleper, M.C., Weilenmann, J. and Wagner, S.M., 2017. Extending the supply chain visibility boundary: Utilizing stakeholders for identifying supply chain sustainability risks. *International Journal of Physical Distribution & Logistics Management*, *47*(1), pp.18-40.

Casali, M., de Mendonça, B.S., de Brito, M.M., dos Santos, M.G.R., Lima, P.G.L., da Silva Siqueira, T.T., Damasceno, J.C. and Bánkuti, F.I., 2020. Information asymmetry among dairy producers in Paraná, Brazil. *Semina: Ciências Agrárias,* 41(1), pp.293-304.

Casley, D. and Kumar, K., 2016. The Collection, Analysis and Use of Monitoring and Evaluation data. [Online]Available at: http://documents.worldbank.org/curated/en/534751468763750439/pdf/multi-page.pdf [Accessed 12 November 2019].

Chaokromthong, K. and Sintao, N., 2021. Sample size estimation using Yamane and Cochran and Krejcie and Morgan and green formulas and Cohen statistical power analysis by G* Power and comparisons. *Apheit International Journal,* 10(2), pp.76-86.

Chisoro, S. and Padayachie, K.M., 2023. Barriers to building productive capabilities: the case of smallholder vegetable farmers in South Africa. Vegetables+Working+Paper_OXFAM_13092023[12].pdf. [Accessed 12 June 2021]

Conceicao, P., Levine, S., Lipton, M. and Warren-Rodriguez, A., 2016. Toward a food secure future: Ensuring food security for sustainable human development in Sub-Saharan Africa. *Food Policy,* 60(2), pp. 1-9.

CTO, 2018. The Retail Value Chain. [Online] Available at: https://pdfs.semanticscholar.org/a57a/596d35f2b368595972213ddb25212602db33.pdf [Accessed 4 November 2019].

Covvey, J.R., McClendon, C. and Gionfriddo, M.R., 2024. Back to the basics: Guidance for formulating good research questions. *Research in Social and Administrative Pharmacy,* 20(1), pp.66-69.

Darakeh, M., Zarafshani, K. and Sharafi, L., 2021. Functions and Challenges of Contract Farming in Kermanshah Province. *Journal of Rural Research*, *12*(2), pp.258-273.

Dessale, M., 2019. Analysis of technical Profitability of small holder wheat-growing farmers of Jamma District, Ethiopia. *Agriculture and Food Security,* 8(1), p. doi:10.1186.

Department of Agriculture Land Reform and Rural Development, 2022. *Annual Report.* DALRRD. Pretoria.

Department of Agriculture, Forestry and Fisheries (DAFF), (2019). *A profile of the South African tomato market value chain*. Pretoria.

Department of Agriculture Forestry and fisheries, 2018. *Annual report.* DAFF. Pretoria.

Department of Agriculture Forestry and Fisheries, 2019. Economic Review of the South African Agriculture. [Online] Available at: https://www.daff.gov.za/Daffweb3/Portals/0/Statistics%20and%20Economic%20Analysis/Statistical%20Information/Economic%20Review%202017%20-18.pdf [Accessed 1 August 2020].

Department of Rural Development and Land Reform, 2016. *Vhembe District Municipality Final Report Agri-Park Master Business Plan*. DRDLR. Pretoria.

Dhillon, R. & Moncur, Q., 2023. Small-Scale Farming: A Review of Challenges and Potential Opportunities Offered by Technological Advancements. *Sustainability,* 15(2), pp. 1-16.

Elmurodov, M., 2023. Technical Elements Of Drip Irrigation Technology. *Pedagogical Sciences And Teaching Methods,* 2(22), pp.88-89.

Ejike, R.D., Osuji, E.E., Effiong, J.A.L. and Agu, C.G., 2018. Gender dimension in agricultural food value chain development in Nigeria: The women perspective. *International Journal of Agriculture and Earth Science,* 4(3), pp.37-45.

Fan, S. and Rue, C., 2020. The role of smallholder farms in a changing world. The role of smallholder farms in food and nutrition security, pp.13-28.

Feukeng, F. T. *et al*., 2023. Return on investment of the International Potato Center–led seed system interventions in Malawi. *Journal of Crop Science,* 64(3), pp. 1328-1339.

Food and Agriculture Organisation, 2016. Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade. [Online] Available at: http://www.fao.org/3/a-bo092e.pdf [Accessed 6 August 2020].

Food and Agriculture Organisation, 2018. Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade. [Online] Available at: http://www.fao.org/3/a-BO092E.pdf [Accessed 30 October 2019].

Food Credence Attributes: A Conceptual Framework of Supply Chain Stakeholders, Their Motives, and Mechanisms to Address Information Asymmetry. *Foods,* 12(3), p.538.

Frederick, S., 2018. Global value chain mapping. [Online] Available at: https://www.elgaronline.com/view/edcoll/9781788113762/9781788113762.00007.xml [Accessed 30 October 2019].

Glazebrook, T. and Opoku, E., 2020. Gender and sustainability: Learning from women's farming in Africa. *Sustainability,* 12(24), p.10483.

Greenberg, S., 2019. Smallholders and agro-food value chains in South Africa Emerging practices, emerging challenges. [Online] Available at: https://media.africaportal.org/documents/value_chains_web.pdf [Accessed 5 August 2020].

Hambloch, C., 2022. Contract farming and everyday acts of resistance: Oil palm contract farmers in the Philippines. *Journal of Agrarian Change,* 22(1), pp.58-76.

Hanks, G., 2018. Steps in the Retail Value Chain. [Online] Available at: https://smallbusiness.chron.com/steps-retail-value-chain-69900.html [Accessed 4 September 2019].

Hassan, A. Y. and Nasereddin, H., 2018. Information sharing characteristics in supply chain Management. *International Journal of Business and Management Science,* 4(1), pp. 1-10.

Hlatshwayo, S.I., Ngidi, M., Ojo, T., Modi, A.T., Mabhaudhi, T. and Slotow, R., 2021. A typology of the level of market participation among smallholder farmers in South Africa: Limpopo and Mpumalanga Provinces. *Sustainability,* 13(14), p.7699.

Hong, X., He, Y., Zhou, P. & Chen, J., 2023. Demand information sharing in a contract farming supply chain. *European Journal of Operational Research,* 309(2), pp. 560-577.

Indrayadi, T., 2020. How to Select Participants in My Research Study: Sampling in Quasi-Experiment Research. *International Journal of Social Relevance & Concern,* 8(5).

Jacques, T., 2019. Agricultural Value Chains in Developing Countries A Framework for Analysis. [Online] Available at: https://ageconsearch.umn.edu/record/103987/ [Accessed 30 October 2019].

Johann, W., Drimie, S. and Blignaut, J., 2018. *The Struggles of Smallholder Farmers: A Cause of Modern Agricultural Value Chains in South Africa*. Pretoria, Intech open.

Kaipa, R., Holmostrom , J., Smaros, J. and Rajala, R., 2017. Information sharing for sales and operations planning: Contextualized solutions and mechanisms. *Journal of Operations Management,* 52(2017), pp. 15-29.

Khapayi, M. and Celleirs , P., 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension,* 44(1), pp. 25-41.

Kumar, S. and Sharma, A., 2016. Agricultural Value Chains in India: Prospects and Challenges. [Online] Available at: www.cuts-citee.org/pdf/Agricultural_Value_Chains_in_India_Prospects_and_Challenges.pdf [Accessed 6 August 2020].

Kwikiiriza, S., 2022. *Evaluation of horticultural practices for tropical squash production and marketing among smallholder youth farmers in Kamuli, Uganda*. (Doctoral dissertation, Iowa State University).

Limpopo Department of Agriculture and Rural Development, 2014. *Nwanedi Agriculture Development Infrastructure Masterplan,* Polokwane: LDARD

Loki, O. and Mdoda, L., 2023. Assessing the contribution and impact of access to extension services toward sustainable livelihoods and self-reliance in Eastern Cape Province, South Africa. *African Journal of Food, Agriculture, Nutrition and Development*, 23(4), pp.23000-23025.

Losch, B., 2020. Thematic study international experiences of support policies for smallholders: A review and an exploration of underlying rationale and narratives. [Online] Available at: https://repository.uwc.ac.za/xmlui/bitstream/handle/10566/5234/20200331%20FINAL%20GTAC%20Thematic%20Study_International%20Experience%20branded.pdf?sequence=1andisAllowed=y [Accessed 2 August 2020].

Mabhaudhi, T., 2018. *Prospects for Improving Irrigated Agriculture in Southern Africa: Linkage Water, Energy and Food.* Switzerland: CCBY.

Mahlangu, S.A., Belete, A., Hlongwane, J.J., Luvhengo, U. and Mazibuko, N., 2020.Identifying potential markets for African leafy vegetables: Case study of farming households in Limpopo Province, South Africa. *International Journal of Agronomy,* 2020, pp.1-8.

Mcleod, S., 2023. Qualitative Vs Quantitative Research Methods & Data Analysis. Simply psychology. Org Available: https://www. Simply psychology. org/qualitative-quantitative . html [Accessed Feb. 12th, 2023].

Mmbengwa, V.M., Rambau, K., Rakuambo, J.N. and Qin, X., 2020. Key factors for the improvement of smallholder farmers' participation in agro-processing industries of Gauteng Province of Republic of South Africa: lessons for the extension advisory services. *South African Journal of Agricultural Extension,* 48(2), pp.153-165.

Makombe, G., 2017. An analysis of the productivity and technical Profitability of smallholder irrigation in Ethiopia. *Scielo*, 43(1), pp. 48-58.

Mashiloane, M., Mafini, C. and Pooe, R., 2018. Supply chain dynamism, information sharing, interorganisational relationships and supply chain performance in the manufacturing sector. *AOSIS*, 18(1), pp. 34-45.

Maponya, P, 2016. An Evaluation of Market Participation Challenges of Smllaholder Farmers in ZUle Land District. *African Journal of Business and Economic Research,* 11(1), pp. 117-142. [Accessed 3 November 2019].

Maponya, P., 2021. Opportunities and constraints faced by smallholder farmers in the Vhembe District, Limpopo Province in South Africa. *Circular Economy and Sustainability*, 1(4), pp.1387-1400.

Maponya, P. and Mpandeli, S., 2012. Climate change and agricultural production in South Africa: Impacts and adaptation options. *Journal of Agricultural Science,* 4(10), p.48.

Mathu, K., 2018. Supply chain collaboration and integration enhance. *South African Journal of Business Management*, 2(4), pp. 1-8.

Mathu, K., 2019. The information technology role in supplier-customer information-sharing in the supply chain management of South African small and medium-sized enterprises. *South African Journal of Economic and Management Sciences*, 22(1), pp. 13-24.

Masuku, M.M., Mthembu, Z. and Mlambo, V.H., 2023. Gendered effects of land access and ownership on food security in rural settings in South Africa. *Frontiers in Sustainable Food Systems*, 7, pp.1-8.

Maponya, P., 2021. Opportunities and constraints faced by smallholder farmers in the Vhembe District, Limpopo Province in South Africa. *Circular Economy and Sustainability,* 1(4), pp.1387-1400.

Mitra, S., Mookherjee, D., Torero, M. & Visaria, S., 2018. Asymmetric Information and Middleman Margins: An Experiment with Indian Potato Farmers. *The Review of Economics and Statistics,* C(1), pp. 1-13.

Muzekenyi, M., Zuwarimwe, J. and Kilonzo, B.M., 2022. Utilizing small-scale commercial farming to enhance local economic development in South Africa. *Journal of Contemporary Management,* 19(2), pp.22-39

Ouko, K.O., Ogola, J.R.O., Ng'on'ga, C.A. and Wairimu, J.R., 2022. Youth involvement in agripreneurship as Nexus for poverty reduction and rural employment in Kenya. *Cogent Social Sciences,* 8(1), p.2078527.

Pankowska, M., 2019. Information Technology Outsourcing Chain: *Sustainability ,* 11(3), pp. 1-28.

Piabuo, S.M., Yakan, H.B., Puatwoe, J.T., Nonzienwo, V.Y. and Mamboh, T.R., 2020. Effect of rural farmers' access to information on price and profits in Cameroon. *Cogent Food & Agriculture,* 6(1), p.1799530.

Pienaar, L. and Traub, L. N., 2015. *Understanding the smallholder farmer in South Africa: Towards a sustainable livelihood's classification*. Milan, ICA

Phillips, L., 2012. How agri-food value chains work. [Online] Available at: https://www.farmersweekly.co.za/agri-business/agribusinesses/how-agri-food-value-chainswork/ [Accessed 3 November 2019].

Prabhakar, S.V.R.K., 2021. A succinct review and analysis of drivers and impacts of agricultural land transformations in Asia. *Land use policy,* 102, p.105238.

Pratap, A., 2018. Walmart value chain analysis. [Online]Available at: https://notesmatic.com/2017/05/walmart-value-chain-analysis/ [Accessed 4 November 2019].

Rather, A.M.U.D., Hajam, M.A., Bhat, M.S.A. and Malik, M.I., 2023. *Horticulture: Principles and practices*. Academic Guru Publishing House. Pp11.

Rex, E., Brunklaus, B. and Lorentzon, K., 2015. *Energy Profitability along the value chain: Ways of Working for Increased Competitiveness*, Stockholm: SP.

Rivaldy, M.L. and Pratama, B.D.S., 2023. Value Chain Analysis in Retail Shop Case Study:"Dizzle Otx Game Shop". *International Journal of Social Health*, 2(4), pp.197-201.

Sakho-Jimbira, S. and Hathie, I., 2020. *The future of agriculture in Sub-Saharan Africa*. Policy brief, 2(3), p.18.

Scholes, R. and Engelbrecht, F., 2021. *Climate impacts in southern Africa during the 21st Century.* Report for Earthjustice and the Centre for Environmental Rights. Global Change Institute, University of Witwatersrand.

Schrobback, P., Zhang, A., Loechel, B., Ricketts, K. and Ingham, A., 2023. Food Credence Attributes: A Conceptual Framework of Supply Chain Stakeholders, Their Motives, and Mechanisms to Address Information Asymmetry. *Foods,* 12(3), p.538.

Sihlobo, W. and Qobo, 2021. *Addressing Constraints to South Africa's Agriculture Inclusiveness.* Southern Centre for Inequality Studies, University of Witwatersrand.

Skinner, C., 2020. Quantitative research. In, *Handbook for Research Students in the Social Sciences*. (pp. 215-224). Routledge.

Steenwyk, P., Heun, M.K., Brockway, P., Sousa, T. and Henriques, S., 2022. The contributions of muscle and machine work to land and labor productivity in world agriculture since 1800. *Biophysical Economics and Sustainability,* 7(2), p.2.

Siriwardana, A.N. and Jayawardena, L.N.A.C., 2014. Socio-demographic factors contributing to the productivity in paddy farming: A case study. Tropical Agricultural Research Vol. 25 (3), p 437 – 444.

Tanumihardjo, S. *et al*., 2019. Maize agro-food systems to ensure food and nutrition security in reference to the Sustainable Development Goals. *Global Food Security,* 12(4), pp. 1-9.

Trade Conference International, 2018. Theory of Constraints Institute. [Online]Available at: https://www.tocinstitute.org/the-goal-summary.html [Accessed 5 November 2019].

Toyon, M.A.S., 2021. Explanatory sequential design of mixed methods research: Phases and challenges. *International Journal of Research in Business and Social Science* (2147-4478), 10(5), pp.253-260.

Trooster, W., Auerbach, R. and Haysom, G., 2020. Strengthening participation in the organic value chain for small-scale farmers in Southern KwaZulu-Natal, South Africa. In, *Organic Food Systems: Meeting the needs of Southern Africa*. CABI, Wallingford, England.

Tsvuura, S., Mudhara, M. and Chimonyo, M., 2021. Gender-Differentiated Contribution of Goat Farming to Household Income and Food Security in Semi-arid Areas of Msinga, South Africa. *Journal of Agricultural Science*, 13(9), p.73.

Ullah, A., Arshad, M., Kächele, H., Zeb, A., Mahmood, N. and Müller, K., 2020. Socio-economic analysis of farmers facing asymmetric information in inputs markets: Evidence from the rainfed zone of Pakistan. *Technology in Society,* 63, p.101405.

Wolf, C. & Karszes, J., 2023. Financial risk and resiliency on US dairy farms: Measures, thresholds, and management implications. *Journal of Dairy Science,* 106(5), pp. 3301-3311.

Yigezu Wendimu, G., 2021. The challenges and prospects of Ethiopian agriculture. *Cogent Food & Agriculture,* 7(1), p.1923619.

Zhonghua, Y. and Ling, Z., 2018. Information Sharing in Supply Chain: A Review. *Journal of Digital Information Management,* 11(2), pp. 125-131.

Zantsi, S., 2021. *Unlocking the potential of the emerging smallholder farming sector in South African agriculture: An agent-based approach*. (Doctoral Thesis) Stellenbosch: Stellenbosch University

ANNEXURE 1: ETHICAL CLEARANCE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr NP Livhebe

STUDENT NO:
19017665

PROJECT TITLE: **Information asymmetry and efficiency of tomato and butternut value chains: A case of Nwanedi Agri-hub.**

ETHICAL CLEARENCE NO: SARDF/20/IRD/08/0212

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr M Manjoro	University of Venda	Supervisor
Dr J Zuwarimwe	University of Venda	Co - Supervisor
Mr NP Livhebe	University of Venda	Investigator – Student

Type: Masters Research
Risk: Minimal risk to humans, animals or environment
Approval Period: November 2020 - November 2022

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project.
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately.
  - New institutional rules, national legislation or international conventions deem it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: September 2020

Name of the RESSC Chairperson of the Committee: Prof Takalani Mashau

UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2020 -12- 2
Private Bag X5050
Thohoyandou 0950

Signature:

ANNEXURE 2: STRUCTURED RESEARCH QUESTIONNAIRE

University of Venda

School of Agriculture

Institute for Rural Development

+27159628812

Back ground

University of Venda has entered into an agreement with the Department of Agriculture and Rural Development and the Management of Nwanedi Secondary Cooperation to work together in finding ways to improve the performance of the Nwanedi irrigation scheme. As part of the agreement the University committed to conduct research and avail relevant information that will lead to improved decision-making by the farmers as they carry out their farming activities. The University through the School of Agriculture and the Institute for Rural Development will involve itself in carrying out various research on farming activities around the irrigation scheme. From the discussions previously the management of Nwanedi Cooperative committed that the farmers will cooperate in the research through providing relevant data as the results will be useful in finding ways to improve farmers' productivity. The data will only be used for the purpose of the research and feedback will be given to the farmers about the results. The University also committed to involve its students in the research process. It is within this background that this questionnaire is being administered to you soliciting for data on various aspects of your farming activities. You are free to participate in the research, therefore, your participation is voluntary and you are therefore kindly being asked to provide answers to the following questions as truthfully as you can. The information will only be used for the purpose of the research.

May you provide us therefore with the following information?

1. Gender of respondent
2. Irrigated Farm size
3. Age
4. Education level
5. How long have you been in the farming business?

6. Other than farming what are the other sources of income for the family?

Farm income	Non-farm income sources

7. How many people are being employed at your farm?

Family labour				Hired labour			
Male		Female		Male		Female	
Seasonal	Permanent	Seasonal	Permanent	Seasonal	Permanent	Seasonal	Permanent

8. What is your household size?

M ale		Female	
Under 18 years	Over 18 years	Under 18 years	Over 18 years

9. In the past season what crops were grown?

Season	Crops grown	Area planted	Yield	Quantity sold	Price per unit
Season 1					
Season 2					
Season 3					

10. For each of the crops grown in the past year, please provide the cost on:

Season	Crops	Fertilizers	Seeds	Electricity	Labour	Transport cost	Packaging cost	Others
Season 1								
Season 2								

Season 3								

11. Of the income from irrigation farming how much was used to:

	Buy farming equipment	Build a housing	Pay for education	Savings	Pay workers	Others
Season 1						
Season 2						
Season 3						

12. Who are the players along the value chain for the crops produced?

Crop	Role Player 1		Role Player 2		Role Player 3		Role Player 4	
	Marketing costs	Selling price	Marketing costs	Selling price	Marketing costs	Selling price	Marketing costs	Selling price

13. How much water was used in the past season? or How much money was used to pay for electricity to pump water?
14. How have your livelihoods changed due to participation in irrigation farming?

Main livelihood sources	
Before participation in irrigation	Currently, since participating in irrigation

15. What are the main challenges that you think will affect the irrigation project?

16. List the main institutions and organizations you are a member of and state the benefits you derive from being a member.

Main institutions and organizations	
Institution	Benefits to members

17. Of the following which ones are being experienced due to the irrigation project?

Possible environmental challenges due to irrigation	
Challenge	Possible solution
Water pollution due to fertilisers and chemical use	
Soil erosion	
Destruction of plants	
New types of pests and diseases	
Saline soils	
Destruction of wild life habitat	
Destruction of aquatic life	
Others	

18. Sources of information of activities along the value chain

Production		Markets		Pricing		Standards	
Type of information	Source	Type of information	Source	Type of information	Source	Type of information	Source

Thank you very much for your cooperation