PRICE RISK MANAGEMENT AMONG SMALLSCALE TOMATO FARMERS- A CASE OF MWALUMINA AREA IN CHONGWE DISTRICT OF ZAMBIA

By

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September 2020

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Thesis submitted in partial fulfilment of the requirements for the degree of Master in Agricultural Production Chain Management-Horticulture Chains

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SUPERVISOR
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ACKNOWLEDGMENT

But thou O Lord art a shield for me; my glory, and the lifter up of my head.

My sincere gratitude to my supervisor Mr. Petros Maliotis for his invaluable support and guidance to ensure that this thesis is a success. I would also like to thank Ms. Albertien Kijne the coordinator for the APCM-Horticulture chains and Mr. Marco Verschuur the APCM coordinator for their support throughout the programme. I would also like to thank Mr. Fred Bowman for his mentorship and words of encouragement.

I also wish to express my sincere gratitude for the opportunity to study under the distinguished faculty at Van Hall Larenstein University of Applied Sciences and to express my special thanks to the Netherlands government (NUFFIC) for a once in a lifetime opportunity. I also wish to acknowledge the magnanimity of the Dutch people.

DEDICATION

To my sunshine; Febby and Manasseh

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LIST OF ABBREVIATIONS

AGBIT	Agribusiness Incubation Trust
ANOVA	Analysis of Variance
COV	Coefficient of Variance
COVID-19	Corona Virus Disease 2019
CSO	Central Statistics office-Zambia
DRC	Democratic Republic of Congo
FAO	Food and Agricultural Organization
FGD	Focused Group Discussion
FISP	Farmer Input Supply Programme
FREPEGA	Fresh Producers Export Grower Association
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
HACCP	Hazard Analysis and Critical Control Points
IAPRI	Indaba Agricultural Policy Research Institute
IFAD	International Fund for Agricultural development
IPM	Integrated Pest Management
LSD	Least Significant Difference
MAO/MAL	Ministry of Agriculture
MCTI	Ministry of Commerce, Trade and Industry
MIS	Market Information System
MLG	Ministry of Local Government
NUSFAZ	National Union for Small-Scale Farmers in Zambia
OCED	Organization for Economic Cooperation and Development
PPP	Public-Private Partnerships
PRM	Price Risk Management
RUAF	Resource Centre for Urban Agriculture and Forestry
SSA	Sub-Saharan Africa
UN	United Nations
USDA	United States Department for Agriculture
VHL	Van Hall Larenstein University of Applied Sciences
WDI	World Bank Development Indicators
WHO	World Health Organization
ZABS	Zambia Bureau of Standards
ZAMACE	Zambia Agricultural Commodities Exchange
ZAMR	Zambia Agribusiness Market Report
ZDA	Zambia Development Agency
ZNFU	Zambia National Farmers Union
ZWMA	Zambia Weights and Measures Agency

ABSTRACT

The study sought to explore price risk management strategies among tomato farmers and to gain insights on the measures that can be taken to reorganize the tomato value chain to alleviate the problem of price risk for small-scale tomato farmers. Data was collected using household questionnaire survey, semi-structured interviews, and focus group discussions. Quantitative analysis involved the use of means, frequency, percentages, Chi-test, ANOVA, and COV. Qualitative analysis involved thematic coding and transcription. The study found that the tomato value chain in Mwaumina has a market type of governance. Tomato farmers operate as chain actors with the absence of vertical and horizontal integration activities. In the 2019/20 farming season, crop diversification and irrigation were the predominant PRM strategies among the tomato farmers. Large scale farmers grew fewer crops but for more months than medium and small-scale farmers. Large-scale farmers also irrigated their tomato crop for more months than medium and small-scale farmers and were, therefore, able to harvest tomato throughout the year. The Largescale farmers also grew more varieties of tomato than medium and large-scale farmers. There were no cold-storage facilities in the value chain; farmers took produce to the markets as soon as it was harvested to avoid losses. None of the respondents was a member of a tomato cooperative. The majority of farmers practiced fruit size grading but could not bargain for a higher price based on the quality of their produce. None of the farmers practiced 'on-farm' processing of tomato. Only 50% of the farmers accessed extension support in the 2019/20 farming season. less than 50% of the farmers accessed credit during the same period. Non-crop Income diversification activities among the farmers included livestock rearing and off-farm activities. Months of irrigation and variety diversification had a positive effect on the farmer's ability to cope with price risk. Farmers growing fewer crops had a significantly higher income per hectare than farmers growing more crops. Non-crop and off-farm income as a proportion of tomato income was highest for small-scale farmers. Farmers who earned non-crop income had significantly more total income than those who did not. Small-scale farmers were more likely to grow more crops than medium and large-scale farmers. Larger farmers were more likely to irrigate for a longer period than medium and small-scale farmers. Large scale farmers were more likely to grow more varieties than small-scale farmers. Female farmers were more likely to access credit than their male counterparts. There was no cooperation and coordination among actors in the tomato value chain in the area. The chain was characterized by a high level of information asymmetry and low level of trust and transparency. To alleviate price risk for small-scale tomato farmers governance of the chain should be changed to captive and modular governance systems that guarantee reduced information asymmetry, formal cooperation among actors, provision of business services support, and product and process upgrading. Vertical and horizontal integration into the tomato value chain through the building of formalized market institutions like contract farming, forward contracts, market information systems, the formation of cooperatives, commodity exchange, and warehouse receipts. Regulatory changes required include, changes to the current Markets and Bus stations Act to regulate broker activity in markets and to abolish hidden commissions and collusion. Regulations that facilitate the construction of cold storage infrastructure at markets and compensate small-scale farmers for unequal impacts of markets are also required. In case of conflict between parties' regulations on court systems and third-party arbitration are also required. For small-scale tomato farmers to be able to participate sustainably in a reorganized value chain, farmers need to increase their bargaining power. Farmers also need education on product and process upgrading including, HACCP, Global GAP certification, and traceability.

DEFINITION OF TERMS

Price: The value of a good, service, or resource in monetary terms during a transaction. With jurisdiction to this research, it refers to the monetary value of per unit of tomato produce sold at market.

Price variability: The state of prices being variable over a given period of time. In the context of this research will refer to price fluctuations outside the normal seasonal fluctuations caused by yield fluctuations.

Risk: The possibility that an event will produce an unwanted or undesirable outcome. In this study, risk is paired to 'price' to refer to uncertainty arising from price variability and having a negative effect on the revenue of the farmer as a result.

Risk management: The deliberate use of management protocol, policies, and practices to the tasks of risk identification, analysis, assessment, and monitoring (Hardaker et al., 2004).

Coping: A combination of strategies employed by the farmer when confronted with uncertainties resulting from the fluctuation of prices for tomato produce.

Small-scale farmer: Farmers with their limited resource endowments relative to other farmers in the sector and are not using advanced and expensive technologies. Small scale farmers are also defined as those having farms operating on 5 hectares or less.

Household: A house and its occupants taken as unit.

Strategy: A plan to attain a goal or set of goals under a situation of uncertainty. In the context of this research is used in combination with the phrase 'price risk management' in relation to a plan to achieve a set goal under conditions of price uncertainty.

Informal Strategy: Non-institutional farmer level price risk mechanisms

Formal strategy: Binding Institutionalized price risk mechanisms

Soweto: The name of the main wholesale and retail market for fresh fruits and vegetables in Lusaka City.

Off-set: Counteract by having an opposite effect

Tubende: Hidden commission in vernacular

Keywords: *Price variability, price risk, price risk management, formal and informal strategies*

CHAPTER ONE

1.0 BACKGROUND OF THE STUDY

1.1 Overview

This chapter sets the introduction and outlines the background of the study, the research context and research problem, justification, research objective, and limitations of the research.

1.2 Introduction

Zambia is a country in Southern Africa endowed with a large land resource base of approximately 42 million hectares with 1.5 million hectares under cultivation per annum (Ekanayake & Mulenga, 2014). Zambia has abundant water resources for irrigation with 40 percent of water in the entire Southern and Central Africa being found in Zambia alone (ZDA, 2015). A study in 2018 indicated that agriculture contributed 2.58 percent to the country's Gross Domestic Product, in contrast to neighboring Malawi where agriculture contributed 26.1 percent to that countries GDP in 2017 (Statista, 2020), and, Angola with 12 percent contribution of agriculture to GDP in 2017 (MACAUHUB, 2017). In comparison to its neighbours, Zambia's agriculture sector's contribution to economic output is small. Figure 1 shows the trend of the decreasing contribution of the agriculture sector to GDP in Zambia.

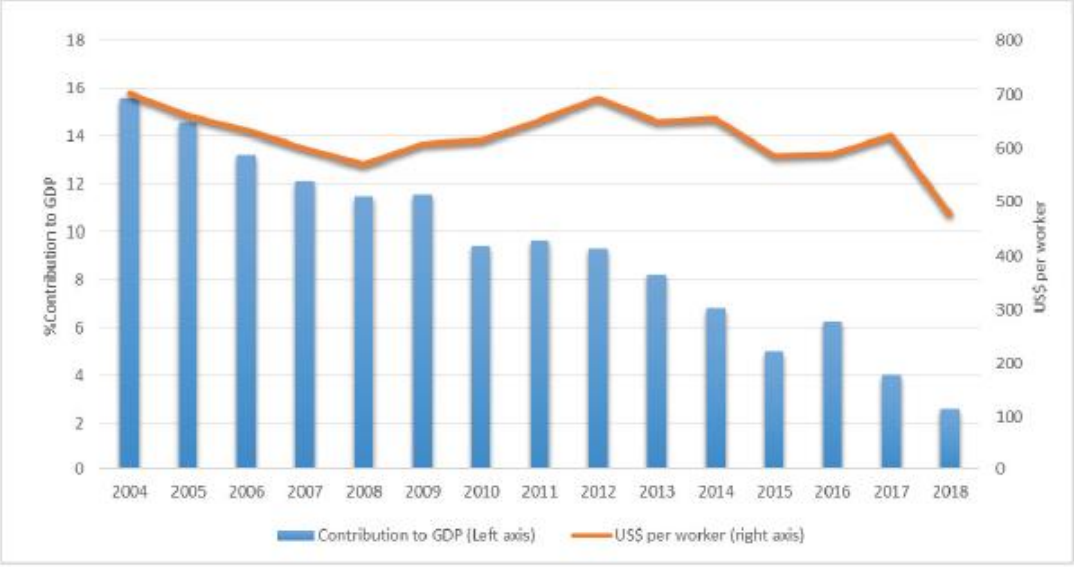

Figure 1: Contribution of Agriculture to Zambian GDP **Source**: Chapoto, et al., 2018

Agriculture has the smallest contribution to GDP among the sectors of the economy that include industry, services, and manufacturing. Despite this, the agricultural sector in Zambia employs 70 percent of the labour force in comparison to industry which has a share of 36 percent of GDP but employing just 7 percent of the labour force and services which contribute 54 percent to GDP and employ 36 percent of the labour force. The agricultural sector is also the rural population's main source of livelihood (WorldBank, 2017). Figure 2 below shows the contribution of the agricultural sector in comparison to other sectors of the economy.

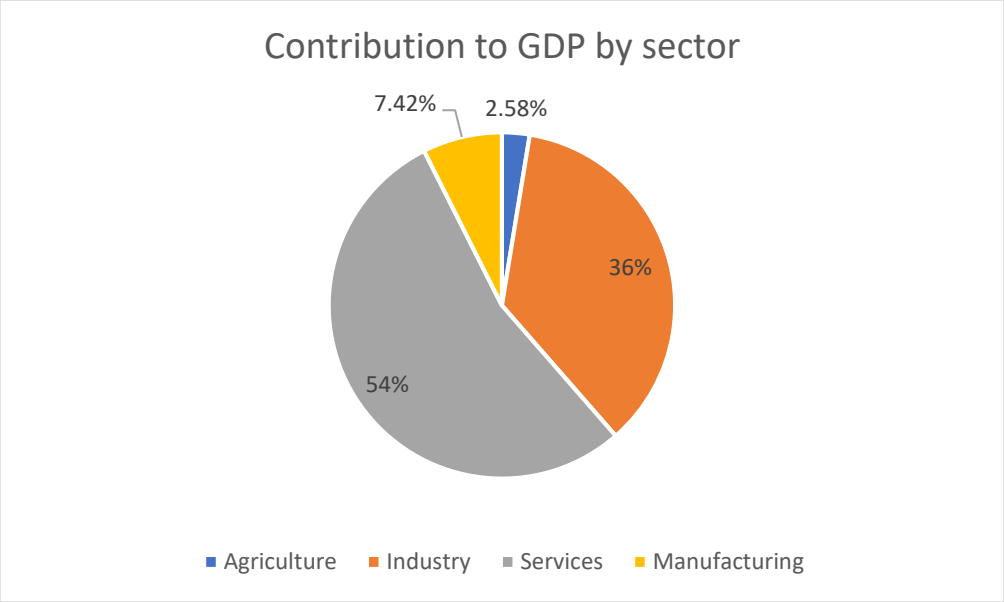

Figure 2: Zambia Contribution to GDP by Sector **Source**: (WDI, 2018)

Agriculture is the most common source of livelihood and income within Zambia's informal sector. Zambian agriculture has three broad categories of farmers: small, medium, and large-scale (IAPRI, 2016). Thirty-four percent of Zambia's total land is agricultural. Small-scale farmer's productivity is characterized by low yields of between 2 and 3 tons/ha, limited diversification, and weak linkages to markets (IFAD, 2019). Small scale farming in Zambia is characterized by the low use of modern technologies and irrigation systems, unlike large and medium-scale farming. Small-scale farmer's production is largely rain-fed, making their crops highly vulnerable to fluctuations in yield (Mendes, et al., 2014), this affects their productivity and livelihoods as a result (IFAD, 2019).

The horticulture sector in Zambia plays an important economic role with 21 percent of the 1.5 million smallholder farmers engaged in horticulture production and with the potential to produce enough vegetables for the domestic and foreign market (AGBIT, 2015). The largest commercial smallholders concentrate on tomatoes, the highest valued horticulture crop in Zambia, but also one of the most difficult to grow (Chapoto, et al., 2012). The tomato value chain is predominantly made up of small and medium-scale farmers with 40 percent of small-scale farm households growing tomato (Chapoto, et al., 2012). In general, the horticulture sector in Zambia is characterized by informal markets that are disorganized and uncompetitive. In addition, informal markets are unregulated and non-transparent with inconsistencies in product supply aggravated by a lack of cold storage facilities that cause high price volatility. Figure 3 depicts the price volatility of tomato in the 2017/2018 season.

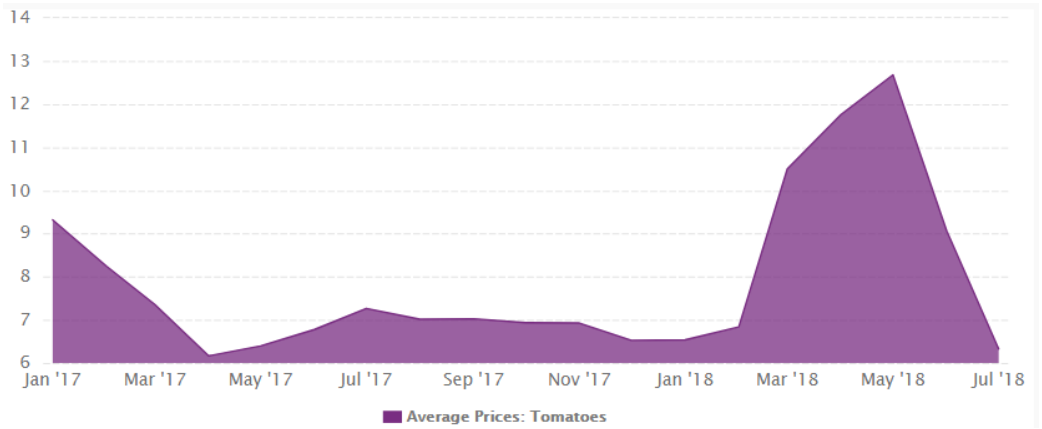

Figure 3: Tomato Price 2017/18 Season **Source**: Adapted from Chapoto et al. (2018)

Despite various mechanisms to stabilize tomato wholesale prices such as short-term storage, direct sourcing from farm areas by traders, and export to areas outside the city, prices remain highly variable. This variability imposes real costs on small and medium-scale farmers (Hichaambwa & Tschirley, 2010). According to Duong et al. (2019), risks associated with agriculture are increasingly diverse, complex, and interconnected. Consequently, there is a need to gain a greater understanding of the nexus of agricultural risks and how farmers respond to risk. According to Antonaci et al. (2014), to cope with various price and production risks, farmers in developing countries normally engage in informal risk management mechanisms. These mechanisms range from income diversification, production strategies, and common risk-sharing mechanisms based on kinship and social networks. However, these traditional risk management methods tend to fail in the presence of larger shocks affecting wider areas.

Taylor et al. (2009) state that farmers across the world face price risk, however in many of these countries farmers have access to a range of risk mitigation products such as forward and futures contracts and insurance policies that shield them from the worst effects of price volatility. Taylor et al. (2009), further states that unlike other countries formal price risk management strategies in Zambia are generally non-existent or only offered at a high price. Rashid & Jayne (2010) state that evidence suggests that without formal risk management, less risky and less profitable farming practices are adopted, resulting in lower productivity and that farm income would increase by 30 percent if effective risk management strategies were adopted.

1.4 Research Context

Commissioner: The following research project was commissioned by the Ministry of Commerce, Trade & Industry. The Ministry of Commerce Trade and Industry (MCTI) is Zambia's principal Government body responsible for administering national policy for private sector development across all sectors of the economy.

Problem Owner: The Ministry of Agriculture, and small-scale tomato farmers in Mwalumina Area of Chongwe District in Lusaka Province of Zambia.

1.4.1 Problem Context

The majority of small-scale tomato farmers in Zambia sell their produce in spot markets located in urban centers in cities. Soweto market is the largest retail and wholesale market in Lusaka for tomatoes. Price variability of tomato produce characterizes the trading of tomatoes at Soweto because of the lack of long-term cold storage infrastructure at Soweto and other fresh produce markets. In addition, the lack of coordination between producers and other actors in the chain means that the regulation of the quantities of tomato produce coming in and out of the market is impossible. The net result is daily and weekly variability of quantities of tomato arriving at the market. This translates into daily and weekly fluctuation in tomato wholesale prices beyond the normal seasonal variation. In addition, the majority of sales at the market are done through brokers who operate in markets where a formal regulatory framework to govern broker activity is absent and where the lack of pricing transparency, uncompetitive and collusive behaviour is rampant. This action by brokers results in distortions in the price of tomato produce at markets and aggravates the problem of price variability in markets. Climatic factors also contribute to price variability as there is limited use of irrigation technologies among small-scale farmers. Small-scale farmers are unable to grow an adequate crop in the drier seasons as a result and have inadequacies in pest and disease control in the rainy season. As a result, small-scale farmers are only able to produce an adequate crop in the late rainy season. This situation leads to seasonal production and concurrent price peaks and troughs that contributes to the overall problem of price variability of tomatoes. The problem tree in Figure 4 below depicts the causes and effect of price variability of tomatoes in the tomato value chain in Zambia.

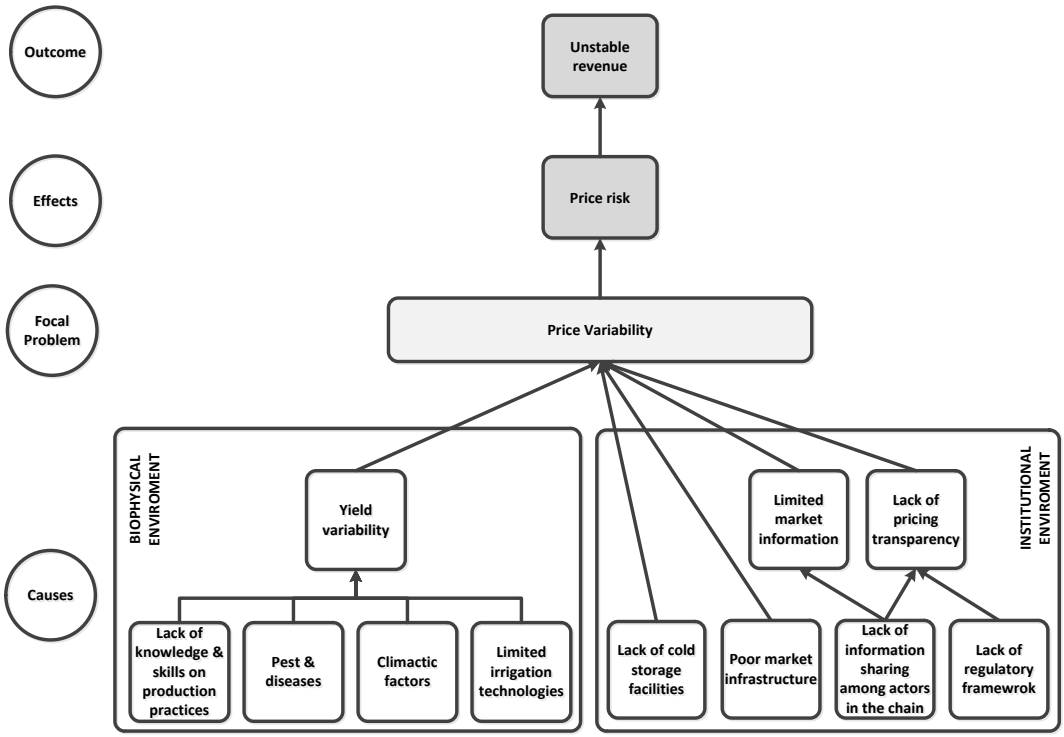

Figure 4: Problem Tree **Source**: Adapted from Hichaambwa & Tschirley (2010)

1.4.2 Research problem

Small scale farmers in the Mwalumina area of Chongwe District of Lusaka Province face price risk when selling their tomatoes at markets. In the past three years, prices of tomato at wholesale and retail levels are highly variable to the detriment of farmers especially small-scale farmers. The variability in prices results in fluctuations of revenues from tomato sales and variability in household income. Price risk hinders farmers from fully pursuing tomato farming as a business. Unstable revenues affect the livelihood of the most vulnerable particularly resource-poor small-scale farmers and reduce their ability to participate effectively in horticultural markets. Small-scale tomato farmers employ informal price risk management strategies (PRM) such as social mechanisms and diversification that still leave them exposed to price risk. The farmers lack institutions to help them cope with price risk more effectively by employing formalized price risk management tools.

The Ministry of Commerce, Trade, and industry as the commissioners of this research project are an interested party. The insights that will be generated from this study will bridge the knowledge gap that exists on the use of formal and non-formal price risk management strategies (PRM) among small-scale tomato farmers.

1.5 Research Objective

To explore (identify/gain insight) on the price risk management strategies (PRM) employed by tomato farmers in the study area and to offer insights on measures to reorganize the tomato value chain to alleviate the problem of price risk for small scale tomato farmers.

1.5.1 Research Questions

Question 1

What is the state of price risk management among tomato farmers in Mwalumina Area?

Sub questions

1. What price risk management strategies (PRM) do tomato farmers employ in Mwalumina Area?
2. Are the price risk management strategies (PRM) employed by tomato farmers in Mwalumina Area effective?
3. What socio-economic factors determine the choice of price risk management strategy among tomato farmers?

Question 2

What measures should be taken to reorganize the tomato value chain in Mwalumina Area to alleviate the problem of price risk?

Sub questions

1. What formal price risk management strategies (PRM) can small-scale tomato farmers adopt to enhance their capability to cope with price risk?
2. What changes can be made to the regulatory framework to alleviate the problem of price risk among small-scale tomato farmers?
3. What changes can be made to the governance of the tomato value chain to alleviate the problem of price risk among small-scale tomato farmers?
4. What characteristics do small-scale farmers need to adopt before they can take up formal price risk management strategies (PRM)?

1.5.2 Conceptual Framework

Figure 5 depicts the conceptual framework of the research. The price variability of tomato is influenced by the institutional and biophysical environment and farmer characteristics. The current institutional and biophysical environment allows for daily and weekly variation in tomato prices beyond the normal seasonal price variations. To cope with price risk, farmers employ informal PRM strategies. Informal PRM still leave farmers vulnerable to price risk. The adoption of formalized PRM strategies may lead to stable revenues from tomato sales and better livelihoods as a result.

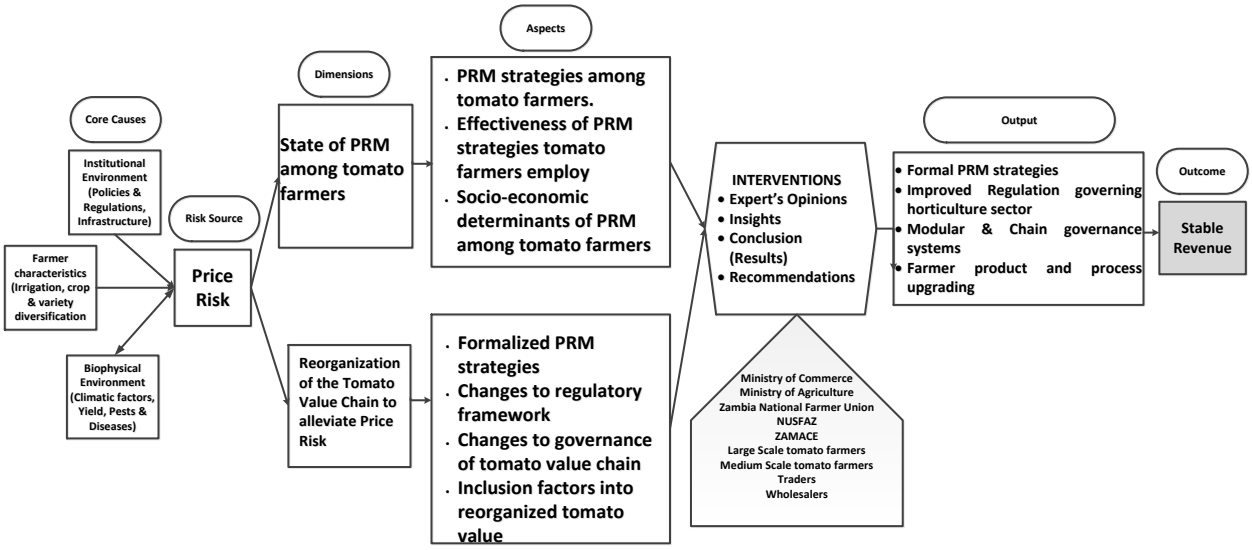

Figure 5: Conceptual Framework **Source:** Owners own

1.6 Limitation and Scope of the study

The study was confined to the Mwalumina Area of Chongwe District which was chosen because of its relatively high number of tomato farmers and its vicinity to the city. The study covered small, medium, and large-scale tomato farmers. The research had some limitations including a sample size smaller than a statistically representative sample which meant that the results could not be generalized to a larger population. The other limitation was that data collection of income diversification activities was limited to the types and number of activities and not the scale of the activities. A comparison of income diversification based on the scale of the activity could not be done therefore.

CHAPTER TWO
2.0 LITERATURE REVIEW
2.1 Overview

Agriculture is characterized as a risky endeavour with numerous uncertainties (Boehlje & Trede, 1977). Volatile commodity prices within inadequate government regulatory and policy framework coupled with uncertain climate factors contribute to the risk facing farmers. Risk is defined as incomplete knowledge where the outcome is unknown (Hardaker, et al., 2004). Risk demotivates farmers from engaging in activities with potentially high returns (Shapiro, et al., 1992). According to Ellis (1998), the impact of risk in agriculture is more severe on poor small-scale farmers than on medium and large-scale farmers. The implication is that risk increases inequality and also results in an unwillingness to adopt innovations. Considerations of uncertainty and risk cannot be escaped when addressing agricultural problems (Aimin, 2010).

2.3 Risks in Agriculture

Agricultural enterprise has always been at risk from factors such as pests and diseases, uncontrollable weather events, and market variability (Duong, et al., 2019). The main types of risk faced by farmers are yield risk and price risk. According to Sadoulet & Janvry, (1995), yield risk is particularly important for the individual producer because yield risk is reflected in price risk. Price risk due to price volatility refers to unexpected price fluctuations that are so large and rapid that it becomes impossible to make predictions (OCDE, 2010). In agriculture, prices are subject to strong fluctuations (Boussard, 2010). The price variability of agricultural produce in African countries has increased as a result of the liberalization reforms in the agricultural sector (Serra, 2015). While farmers in developed countries have access to market-based tools to hedge against price risk such as insurance or futures markets these tools are generally unavailable or very weakly developed in developing countries (Gilbert & Morgan, 2010).

2.3.1 Yield Risk

Yield risk results from yield variability caused by uncertain natural growth processes of crops including weather, pests and disease, and other factors that affect both the quantity and quality of produce (USDA, 2019). Modern irrigation equipment and controlled environments have allowed farmers to improve the degree to which they can manage the influence of natural factors but agricultural production remains much more variable compared to other sectors (Eldukhery, et al., 2010). Small-scale farmers production contributes significantly to household food security and can also contribute to national food security by producing a marketable surplus that feeds rural markets, urban markets, and even international markets through trade (Eldukhery, et al., 2010), but the fact that small scale farmers are resource-poor implies that they cannot invest in production technologies to mitigate against changing environmental condition and are therefore more prone to yield variability and the resultant yield risk.

2.3.2 Price Risk

Price volatility is an important source of market risk in agriculture. The prices of agricultural commodities are extremely volatile. In local markets price risk is sometimes mitigated by natural hedging in which an increase in production results in a decrease in output prices and vice versa. For perishable products, the ability to deliver products to markets on time is very important to offset the problem of market risk. The inability to deliver perishable products to the right market at the right time can impair the efforts of producers. The lack of infrastructure in markets can make the perishability of produce a significant source of risk (Jain & Parshad, 2006). Price or market risk refers to uncertainty about the price producers will receive for their produce or the prices

they must pay for inputs (USDA, 2019). Because of the unpredictability of climate conditions agricultural production is always doomed by variability resulting in volatile outputs' prices (Yassin, 2011). Changes in prices are beyond the control of any individual farmer, and the price of farm products is affected by supply and demand factors and the cost of production (USDA, 2019).

The prices of agricultural products fluctuate not only from year to year, but during the year from month to month, day to day, and even on the same day. The changes in prices may be upward or downward. Price variation cannot be ruled out, for the factors affecting the demand for, and the supply of, agricultural products are continually changing (Kahan, 2008). Price and production risks are highly interrelated because variability in production can result in high food price instability (Braimoh, et al., 2018). Production risk and price risk tend to be negatively correlated, with the result that revenue fluctuates less than either price or yield (Wright, 2009). Sometimes price movements follow seasonal or cyclical trends that can be predicted. Many times, however, supply or demand will change unexpectedly and, in turn, affect the market price (Kahan, 2008). Although certain levels of intra- and inter-seasonal price variability are acceptable in the market, it is the price uncertainty of this price variability that presents a major price risk especially for smallholder farmers (Braimoh, et al., 2018).

Price uncertainty arises from price variability and makes planning difficult for farmers by introducing the element of uncertainty. Price uncertainty is a situation where prices for inputs and outputs differ from what might have been anticipated (Braimoh, et al., 2018). The uncertainty concerning an outcome that involves some loss that negatively affects an individual's well-being is normally associated with the concept of risk (Anton, 2009). Price volatility is the most significant market-related risk facing farmers and other players in agricultural value chains in Zambia (Braimoh, et al., 2018).

2.4 Tomato value chain in Lusaka

The tomato value chain in Lusaka Province is made up of farmers, traders, wholesalers, processors, and retailers. The majority of tomatoes come from large, medium, and small farm areas with large and medium farmers dominating the system. The tomato sector is broken up into the modern and traditional sectors (Tschirley & Hichaambwa, 2010). The traditional sector refers to the part of the chain where the tomato is supplied fresh to the spot market. The modern sector is a formalized sector of the tomato subsector, comprised of processors at the wholesale level and independent and large supermarkets, mini-marts, and small supermarkets at the retail level. The traditional sector of the tomato chain dominates the modern sector in terms of tomato volume as depicted in Figure 6. (Mwiinga, 2009).

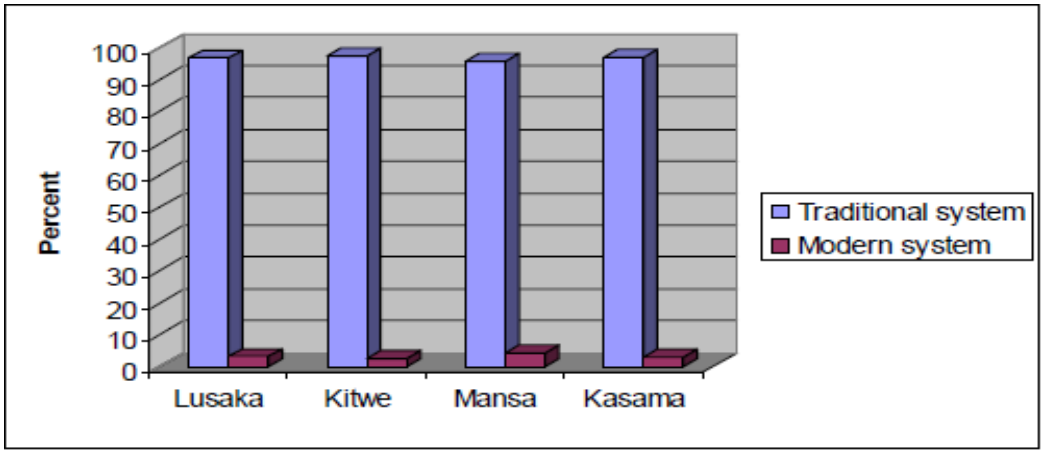

Figure 6: Dominance of the Traditional Sector **Source**: Tschirley & Hichaambwa (2010)

The tomato value chain serving Lusaka City is depicted in figure 7. The majority of the tomato produce marketed in the city is from rural areas with small amounts coming from urban and peri-urban areas. Traders play a greater role when it comes to produce from large-scale farmers, as most small and medium scale farmers prefer to supply their tomato producer directly to wholesalers (Tschirley & Hichaambwa, 2010). Small-scale farmers mostly supply their tomato to market in March to May as a rainfed crop as they have no access to irrigation equipment. Supplies from medium-scale farmers are mostly done in the dry season from May to January. Supplies from large-scale farmers are done throughout the year (Tschirley & Hichaambwa, 2010). The quantities of tomatoes arriving at Soweto market are highly unstable partly due to production disruptions arising from problems with irrigation and pests and diseases among the farmer who supply to the market. More fundamentally, however, quantity fluctuations are driven by very limited ability to coordinate across levels in the system to smooth the flow of product to the market. The limited market information sharing across the chain implies that farmers are never sure of the price of their produce as they supply to market (Tschirley & Hichaambwa, 2010).

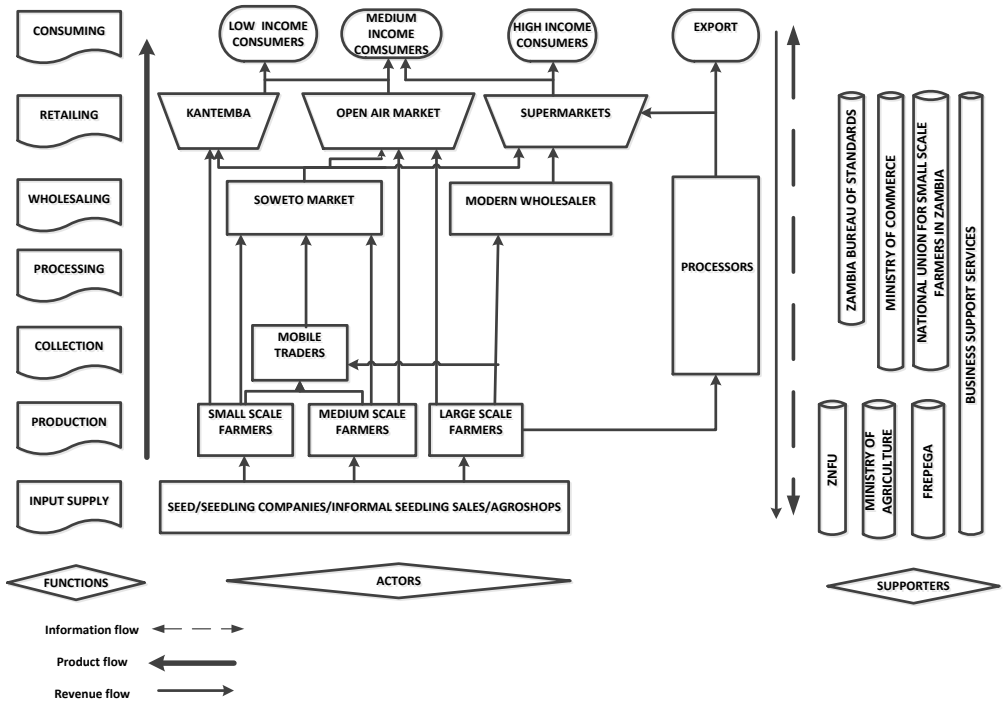

Figure 7: Tomato Value Chain in Lusaka **Source**: Adapted from Tschirley & Hichaambwa, (2010)

2.4.1 Broker and fresh produce markets

Fresh tomato produce sold at spot markets in Zambia involves a mix of brokered and unbrokered transactions. (Tschirley & Hichaambwa, 2010). The majority of tomato farmers sell through brokers signifying that perishability may be more important than search costs in driving the seller's decision. But there exists an atmosphere of mistrust between farmers and brokers as there is a lack of pricing transparency and routine charging of hidden commissions which affects price stability in markets (Tschirley & Hichaambwa, 2010). Fresh produce like tomato that has a short shelf-life and limits a vegetable grower's ability to conduct an extensive search for buyers or better prices, thus rendering the grower more vulnerable to volatile prices (Schieffer & Vassalos, 2015).

2.4.2 Tomato quality and the modern sector of the tomato value chain

Tomato produce coming from small-scale farmers are sold raw with very little value addition, either at the Soweto wholesale market or at one of the many markets scattered around the city (FAO & RUAF, 2019). Most small-scale farmers cannot supply tomato in the modern sector of the value chain because of the absence of quality and standards such as HACCP that are required to supply to supermarkets. Studies show that the tomato total soluble solid content in tomatoes supplied in the traditional sector is less than the 4 percent that is demanded by processors (Sitko, et al., 2011). Also, small-scale farmers tend to break the contracts (Mwiinga, 2009). Grades and standards allow trading of a product based on specific parameters identifying their quality and other characteristics, thereby making the market more transparent and reducing unpredictable variation in prices. Contracted farmers are offered stable prices for their tomatoes for the whole one-year contract period they enter (Mwiinga, 2009).

2.5 Variability of tomato prices at wholesale markets in Lusaka

The demand and supply of commodities vary over time as such price variability is an inherent and necessary part of marketing systems. Yet excessive price variability imposes large costs on farmers and consumers. Price variability makes trader's activities risky and reduces the kinds of investments in the tomato value chain that are needed to promote long-term productivity (Tschirley, et al., 2012). Price variability is an acceptable feature of any market but it is the unpredictability of this variability that presents a major price risk especially for smallholder farmers. For smallholders, price variability is a risk that affects household income and food security (Kuteya 2016). Studies have shown that price variability for tomatoes is very high in Zambia compared to Mozambique, Sri Lanka, Costa Rica, Taiwan, and the United States. The coefficient of variation for tomato prices is highest in Zambia (Tschirley, et al., 2012). Table 1 depicts the coefficient of variation of price of tomato in Zambia obtained from empirically observed sales frequencies from tomato in a four-year period in Lusaka's Soweto market.

Table 1: Price Risk as a function of farmer productivity

Farmer Productivity	**Number of Sales**	**Mean Price (K/Crate)**	**Std. Error of Mean Price**	**Coefficient of Variation of price**
Lowest	6	33	110	3.33
Middle-Low	18	39	82	2.12
Middle-High	42	39	54	1.38
Highest	129	50	40	0.80
Note: mean and variance of prices are computed from daily average price data. Tomato prices are per crate. A crate of tomato weighs approximately 35Kg				

Source: Tschirley, et al. (2012)

2.6 Risk Attitudes Among Farmers

According to Mitra & Sharmin, (2019), the risk attitude of farmers may be influenced by demography and socioeconomic characteristics such as age, gender, experience, and education. Risk attitude influences the decisions farmers make in the agricultural production process. Studies show that younger farmers with large farm sizes are more likely to participate in marketing contract agreements in the United States of America (Vassalos & Li, 2016). In Nigeria, it was observed that maintaining a good relationship with traders and selling at a low price

due to perishability, and off-farm income and selling at the local market are the major price risk management strategies for fruits and vegetables employed in Nigeria.

2.7 Formal Price Risk Management Strategies

According to (Galtier, 2009) responses to price volatility can be grouped into those stabilizing prices and those reducing the effects of price instability. The best practices for risk management and price stabilization policy should focus on long-term investments to increase the role of the private sector and build confidence in a market-based approach. Excesses volatility observed in agriculture over recent years has reinforced the argument that public-private partnership is essential for price risk management tools such as forward contracts, contract farming, warehouse receipt systems, and commodity exchanges. However, the adoption of formal price risk management tools such as warehouse receipts and other innovative risk management tools is hampered by the lack of grading standards and proper institutional framework in many African countries.

To cope with price risk farmers may enter into contract farming agreements. Price uncertainty could be greatly reduced if farmers could make advance contracts with buyers of products. In this way, farmers can protect themselves from any price instabilities. Additionally, farmers may also enter into forward contracts. A forward contract is a practice where the buyer and producer agree on a price for the sale of crops in advance of delivery (Kahan, 2008).

Evidence from more developed countries suggests that commodity exchanges are the best option to deal with price risk and market uncertainty. However, in Africa, commodity exchanges are not very common. In the 1990s, despite the market liberalization wave, few countries tried to implement agricultural commodity exchanges. Except for South Africa, most countries in the developing markets failed to implement commodity exchanges. Several factors, including small market sizes, infrastructural and institutional bottlenecks, and government interventions, have hampered the success of commodity exchanges in Africa (Antonaci, et al., 2014).

Another way that farmers can mitigate price risk is through information systems. Information systems are knowledge infrastructures that facilitate the dissemination of information for risk awareness, market decisions, and policy decision-making. For developing countries, enhanced agricultural information systems represent a valuable option to reduce uncertainties about the agricultural sector and increase awareness about price, weather, and other hazard risks, and thereby enable governments and the private sector to better plan their actions and allocate budget where it is most needed (Antonaci, et al., 2014).

According to (Aimin, 2010) It is abundantly clear that considerations of risk cannot be avoided when addressing agricultural issues. In (Aimin, 2010) view neither existing markets nor government policies have solved the farmers' risk exposure problems, and the risk continues to have the potential of adversely affecting farmers' welfare, as well as carrying implications for the long-run organization of agricultural production and the structure of resource ownership in the agricultural sector.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

The research involved both quantitative and qualitative approaches employing descriptive and exploratory research designs. Data collection instruments include survey questionnaires, semi-structured interviews, focus group discussions, and literature review.

3.1 Study Area

The District of Chongwe lies in Lusaka Province in a region associated with poor rainfall of between 800 and 1000 mm per year. The economy is largely agriculturally based on agricultural activities in crop, horticulture, and livestock production (GRZ, 2019). Tomato is the predominant crop grown with farmers following a crop rotation with maize and other vegetables. Due to small plots of land and the need for continuous income, most of the available arable land is cultivated all year round (Jenkins, et al., 2015). It is estimated that 60 percent of the food consumed in Lusaka city is produced in the city region. Chongwe being in the vicinity of the Lusaka City region is perceived as one of the areas critical to the food supply in the city because of the high number of households involved in agricultural activities (FAO & RUAF, 2019). Figure 8 depicts the map of Zambia and the location of Chongwe District.

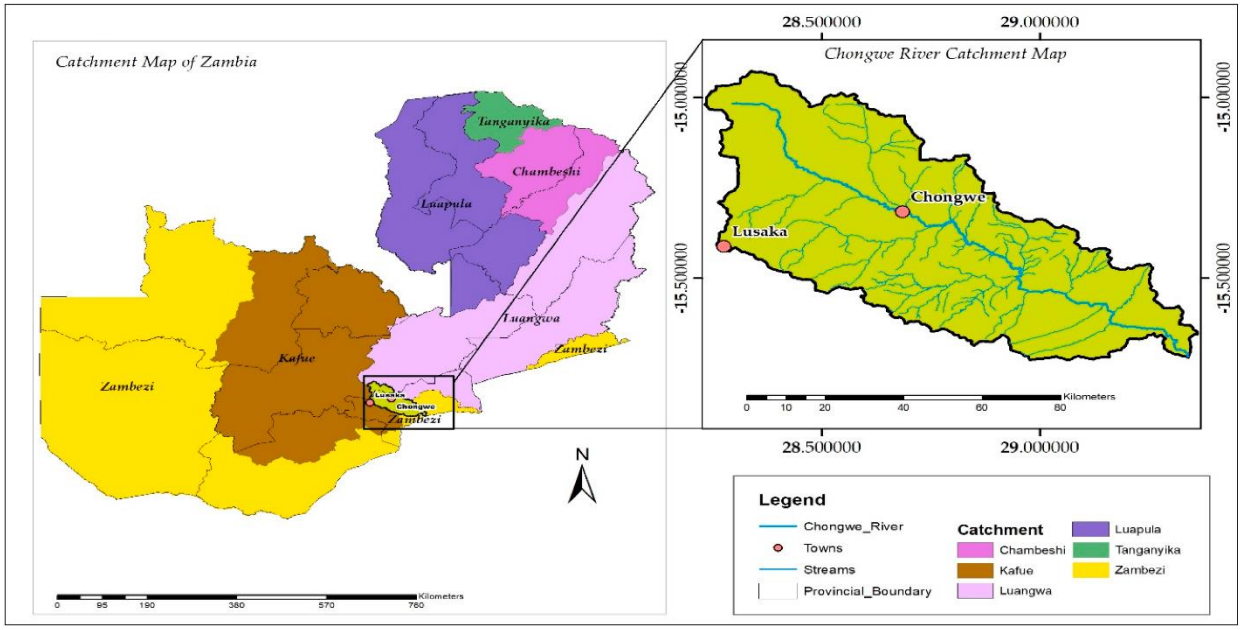

Figure 8: Map of Zambia Showing Chongwe District **Source**: Tena, et., (2019)

3.2 Research Design

Figure 9 below depicts the research framework.

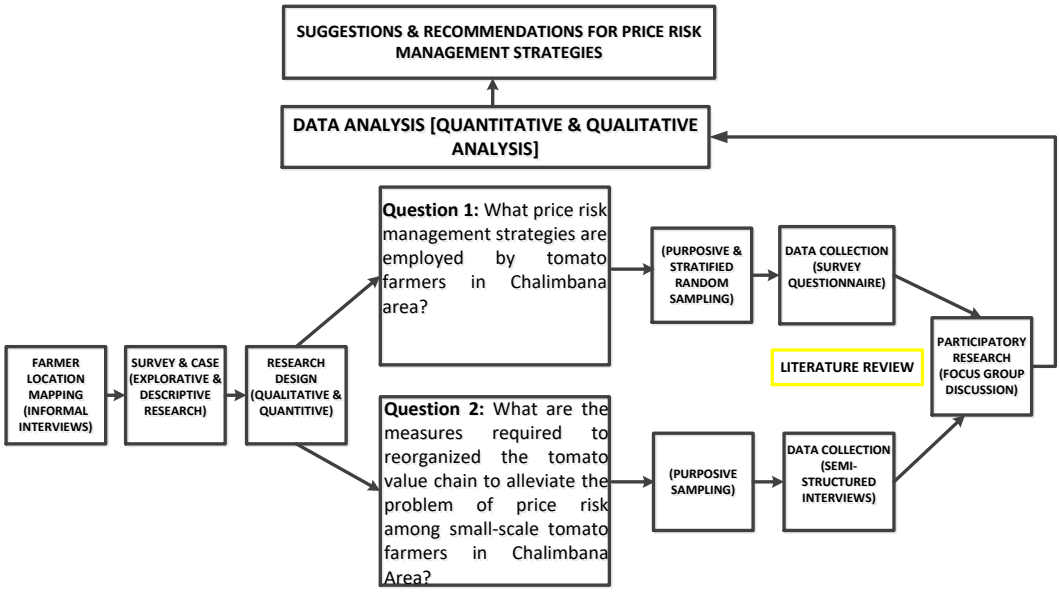

Figure 9: Research Framework **Source:** Author's own

3.3 Field Research in the Context of COVID-19

In line with the recent public health care regulations designating COVID-19 as a notifiable disease, the Zambian government issued regulations on restrictions on foreign travel, and a ban on social gathering and social distancing (MOH, 2020). Van Hall Larenstein University (VHL) also officially communicated to the effect that travel back to home country for data collection was discouraged. To adhere to my government's regulations and the advice of VHL management I did not travel to my home country for data collection. Data was collected via skype and zoom platforms.

Research by Proxy (Surrogate)

I engaged one (01) surrogate enumerator to facilitate data collection. To ensure the accuracy of results I designed an online questionnaire survey with few but highly focused questions. I also designed a checklist for the semi-structured interviews with specific questions. For the focus group discussion (FGD), The enumerator employed the InterVision approach under my close supervision. InterVision allowed for participants to air their opinions on a topic in an ordered manner following a cycle to ensure that the views of all participants were collected.

3.4 Sampling Design and Techniques

The Ministry of Agriculture has divided Chongwe District into 5 zones with each zone divided into 28 agricultural camps. Zones and camps are delimited for administrative and operational reasons. Each camp has an average of 1691 farming households. The sampling of respondents for the household questionnaire survey involved a purposive sampling of one zone chosen based on the convenience of reaching farmers and data collection. Mwalumina Camp was purposively sampled.

Camp officers provided a list of all the tomato farmers in the camp from which a sampling frame was devised. The sample of 5 large-scale farmers (n=5) was collected by purposive sampling because there are very few large-scale farmers. The sample of medium and small-scale farmers was obtained by stratified random sampling to obtain 15 medium-scale farmers (n=15) and 40 small-scale farmers (n=40). The total number of respondents for the household questionnaire survey was 60 respondents (n=60). The sampling of experts and key-informants for the semi-structured interviews involved the purposive sampling of 8 experts (n=8) and 4 key informants (n=4), purposive sampling was used because there are a limited number of experts with information on the tomato value chain in Lusaka. The total number of the sample for the semi-structured interviews was 12 (n=12).

According to Cochran, W. G. (1963), for populations that are large to yield a representative sample for proportions the formula is given by:

$no= Z^2\ p * q/e^2$

Where;

no=Sample population

Z^2*= The abscissa for a normal curve related to an area of α equal to the desired confidence level (95%)*

e= The desired level of precision

p= The estimate of the proportion of an attribute in the population.

q= 1-p

if we assume a large population and we do not know the variability in the population relative price risk management strategies be employed, the resulting sample size is determined to be equal to:

$no= (1.96)^2 *(0.5) *(0.5)/(1-0.5)^2 =$ ***385 farmers***

Since the population of households practicing agriculture in Mwalumina camp is estimated at 1691 households, and since this population is small and represents a finite population, it can be corrected for proportion using the following formula:

n= no/1+ [(no-1)/N]

Where;

no= Sample size of a large population

n= Sample Size

N= Population Size

So that with a population of 1691 our sample size is equal to:

n= 385 /1+ [(385-1)/1691] = ***314 farmers***

Even with the finite population correction, the required sample size for the sample to be representative is 314 farmers. Considering the limited time and resources available to conduct this research, obtaining a sample size of 314 was not practical. Instead, a sample of 60 farmers for the sample was obtained. The generalization of results from this research was therefore limited.

3.5 Data collection and instruments

Data was collected using the following instruments.

Desk Study

Desk research was carried out to obtain secondary data from existing literature sources journal articles, e-books, reports, official government documents, and credible websites. Online sources on the internet were used to source the most current literature relevant to the research problem. Literature review served as a tool for triangulation to establish the reliability of the results from the quantitative survey, semi-structured interviews, and focus group discussion.

Online Questionnaire Survey

The survey was administered online via Microsoft forms. The online survey collected responses from 60 respondents made up of small, medium, and large-scale tomato farmers. The respondents of interest were the small-scale farmers. Medium and large-scale farmers were included for comparison.

Semi-structured Interviews

The semi-structured interviews were conducted online using skype and zoom platforms. The sample was made up of 1 expert from the Zambia National Farmers Union (ZNFU), 1 expert from the National Union of Small-scale farmers in Zambia (NUSFAZ), 1 expert from Zambia Commodity Exchange Limited (ZAMACE), and 1 expert from Indaba Agricultural Policy Research Institute (IAPRI). Experts from the Ministry of Agriculture included 1 District Agriculture Coordinator (DACO), 2 Extension Officers (E.Os), and 1 District Marketing Development Officers (DMDO). The sample of key informants was made up of 2 traders, 1 wholesaler, and 1 processor.

The ZNFU was chosen because it is the largest farmers association in Zambia with a mission to promote and safeguard the interest of all member farmers involved in the business of agriculture in Zambia. NUSFAZ is a recently formed splinter group association from ZNFU focused on small-scale farmers. ZAMACE is a private company that runs Zambia's sole commodity exchange, ZAMACE facilitates for structured market mechanisms among commodity market players to enhance market information and market access. IAPRI are involved in generating empirical evidence for use in influencing government policy on agricultural investments. The Ministries of Agriculture are the problem owners and are also the principal government body for agricultural development in Zambia. Traders, wholesalers and processors are actors in the tomato value chain in Lusaka.

Focus Group Discussion

The selection of the participants for the FGD involved purposive sampling. The purposive sampling was done to have an equal number of males and females. A sample of 20 respondents was obtained from the 60 respondents originally sampled for the quantitative survey. The sample was made up of 2 large-scale farmers, 4 medium-scale

farmers, and 14 small-scale farmers. The respondents were split into two groups of 10 participants. One group had 6 males and 4 females and the other group had 4 males and 6 females. Preference ranking was used as a ranking and scoring tool.

3.6 Data Analysis

Quantitative data analysis was carried out using SPSS (Statistical Package for Social Sciences-Version 25) and Microsoft Excel. Statistical analysis involved the use of means, frequencies, percentages, coefficient of variance (COV), analysis of variance (ANOVA), independent t-test, and Chi-test. Qualitative data was analyzed by thematic coding and transcription using Microsoft excel and Microsoft word.

CHAPTER FOUR

4.0 RESULTS

The following chapter presents the results from the household questionnaire survey, expert and key-informant interviews, and focus group discussion. All the graphs and tables in this chapter are were developed using data sourced from the household survey, experts, and key-informant interviews and focus group discussions.

4.1 Results from the Household Questionnaire Survey

Before analysis, diagnostic tests in the case of scale data were carried out including test of normality using the Kolmogorov Smirnov Test and the skewness and Kurtosis. In case of failure of a test variable to satisfy the normality test, scale data was transformed and recoding into ordinal data.

4.1.1 Demographic characteristics of the Sample

The following chapter presents the demographic characteristics of the sample generated using SPSS version 25 and Microsoft Excel 2016. The graphs were generated from data from the questionnaire survey.

A] Categorical variables of demographic characteristics

Figures 10, 11, and 12 depict the demographic characteristics of the sample (categorical variables).

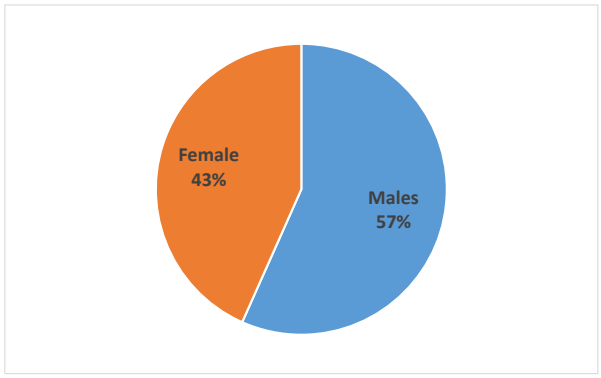

Figure 10: Gender

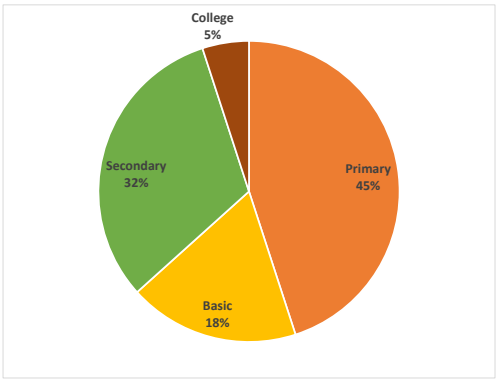

Figure 11: Education Level

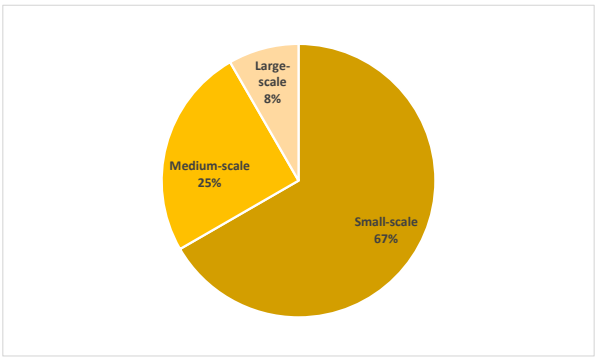

Figure 12: Farmer Size Class

B] Continuous variables of demographic characteristics

Figures 13 to 18 depict the demographic characteristics of the sample (continuous variables)

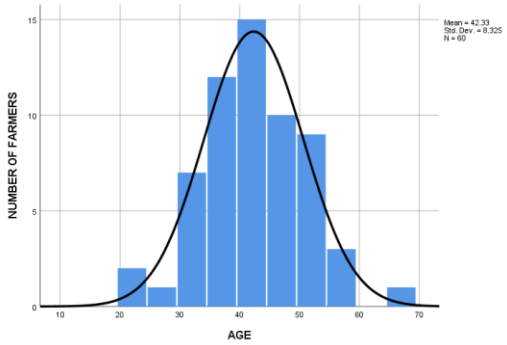

Figure 13: Age

Skewness: 0.064, **Ketosis**: 0.347

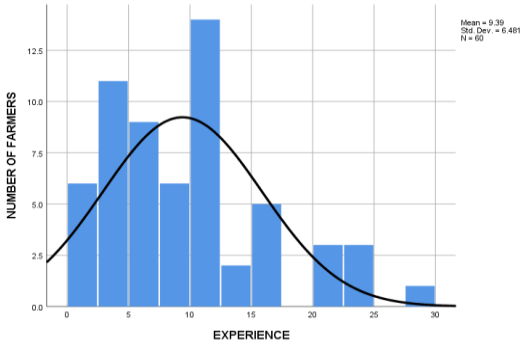

Figure 14: Number of years in Tomato Farming

Skewness: 0.885, **Ketosis**: 0.338

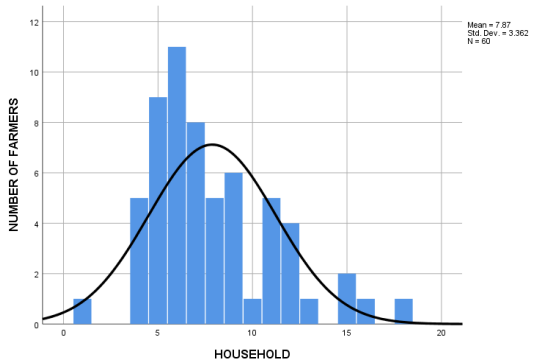

Figure 15:Number of Household Members

Skewness: 0.919, **Ketosis**: 0.741

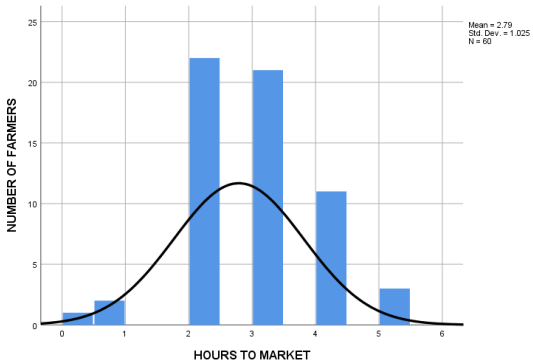

Figure 16:Distance to market in hours

Skewness: 0.41, **Ketosis**: 0.166

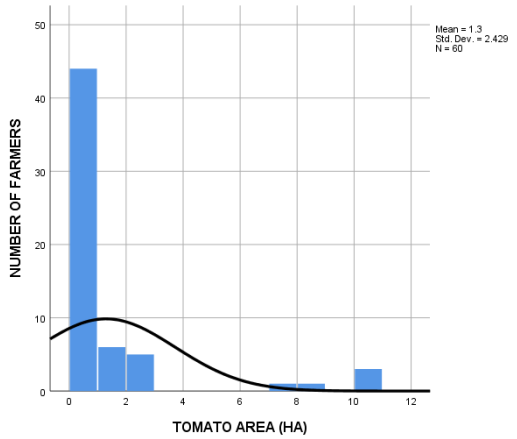

Figure 17: Area planted to tomato

Skewness: 2.972, **Ketosis**: 7.800

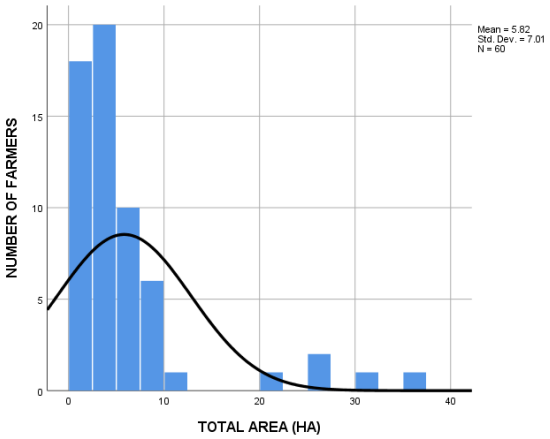

Figure 18: Total Area of Land owned by farmer

Skewness: 2.755, **Ketosis**: 7.608

4.1.2 Price Risk Management Strategies employed by tomato farmers in the Study Area

This aspect of the research objective sought to identify the PRM strategies currently employed by farmers in the study area.

Formal PRM strategies

Figure 19 shows that none of the farmers sampled are employing formal PRM strategies (Forward contracts, Contract farming, Commodity Exchange (Futures market; Warehouse Receipts) or MIS.

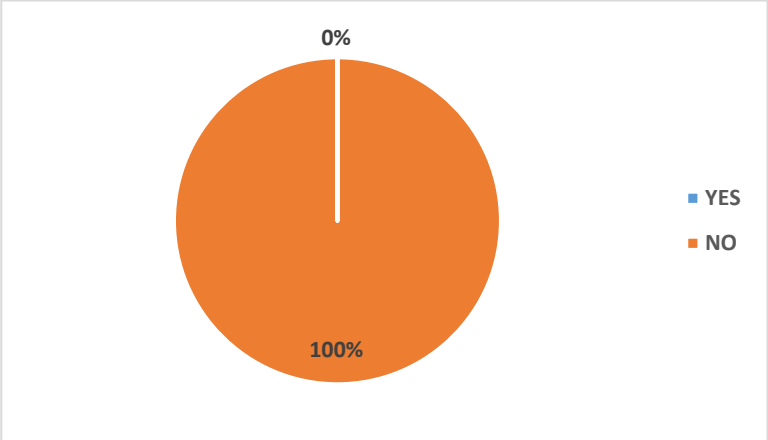

Figure 19: Number of farmers employing formal PRM

Informal PRM strategies

Figure 20 shows the informal PRM strategies employed tomato farmers in the study area. None of the farmers sampled were practicing on-farm processing and cold storage. None of the farmers sampled are members of tomato cooperatives.

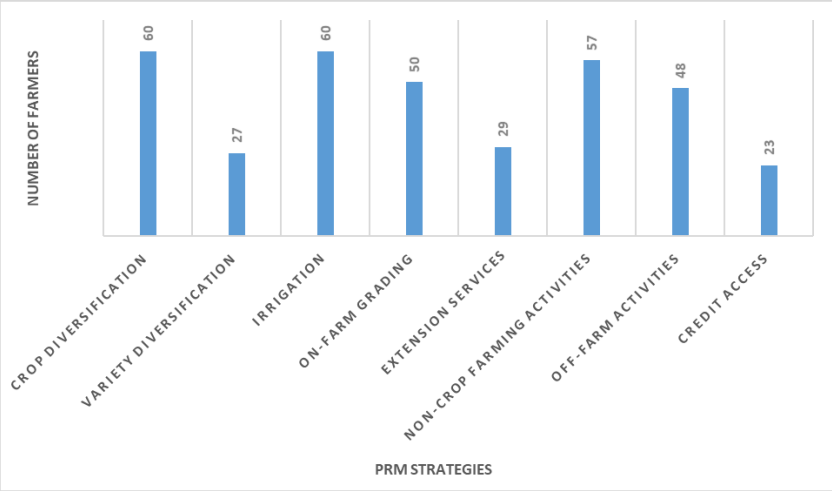

Figure 20:PRM strategies used by farmers in Mwalumina Area

Crop Diversification

Figure 21 shows the extent of crop diversification among the farmers in the study area in terms of number crops other than tomato and month of crop diversification in the last 12 months.

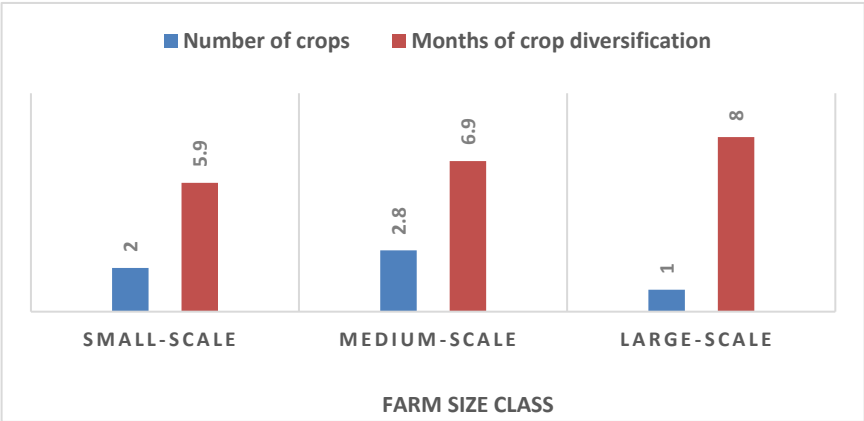

Figure 21: Extent of crop diversification among tomato farmers

Variety Diversification (Variety Staggering)

Figure 22 shows the extent of variety diversification (staggering) among the farmers in the study area in terms of number varieties cultivated and month of variety diversification in the last 12 months

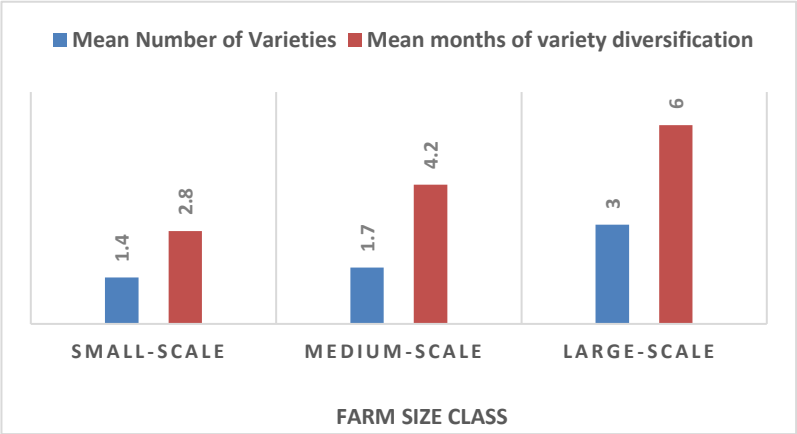

Figure 22: Extent of variety Diversification among tomato farmers

Irrigation

Figure 23 shows the extent of irrigation among tomato farmers in the area in terms of the proportion of land under irrigation cover and the number of months of irrigation in the last 12 months.

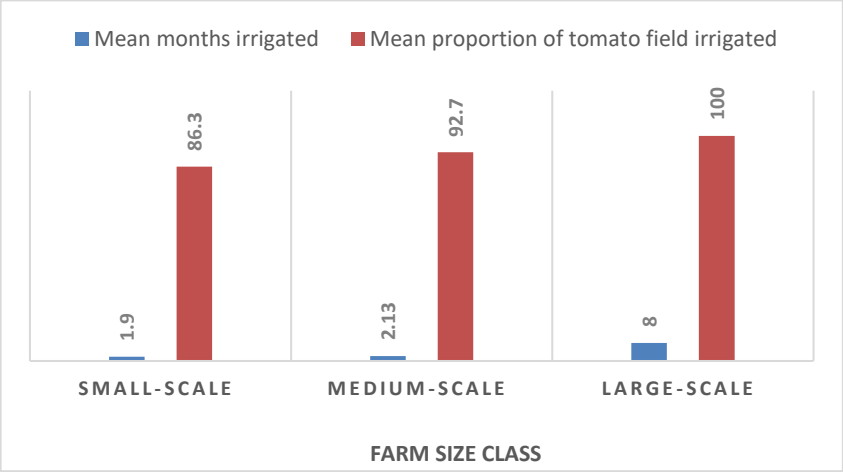

Figure 23: Extent of irrigation among tomato farmers

Extent Extension Services

Figure 24 shows the extent of extension services access among the farmers in the last 12 months. All the farmers who access extension services received it from the government.

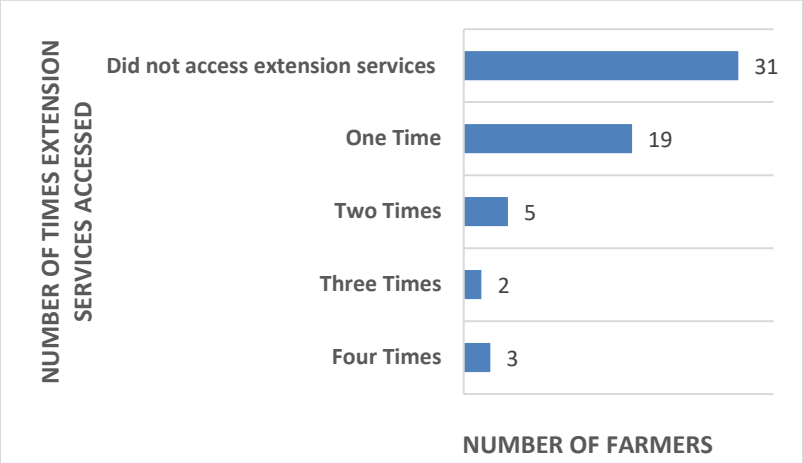

Figure 24: Extent of extension service access among tomato farmers

Credit Access

Figure 25 shows the extent of credit access among the sample. The majority of the farmers did not access credit.

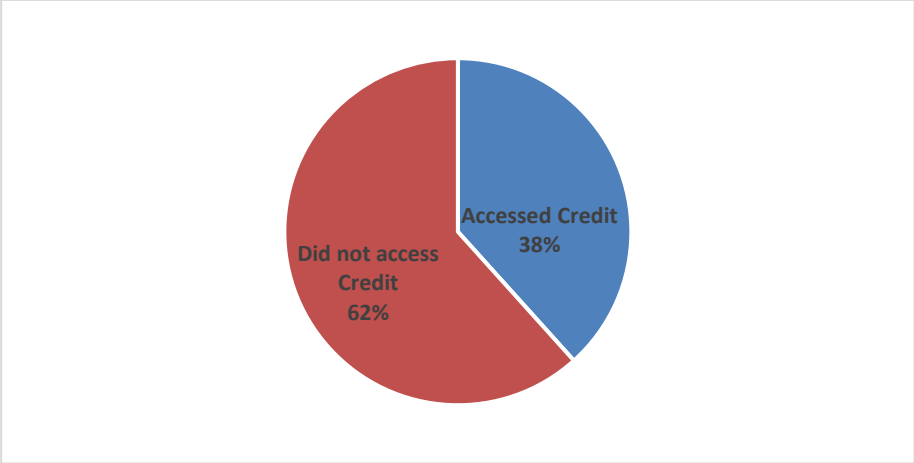

Figure 25: Extent of credit Access

Figure 26 shows the sources of credit among the farmers.

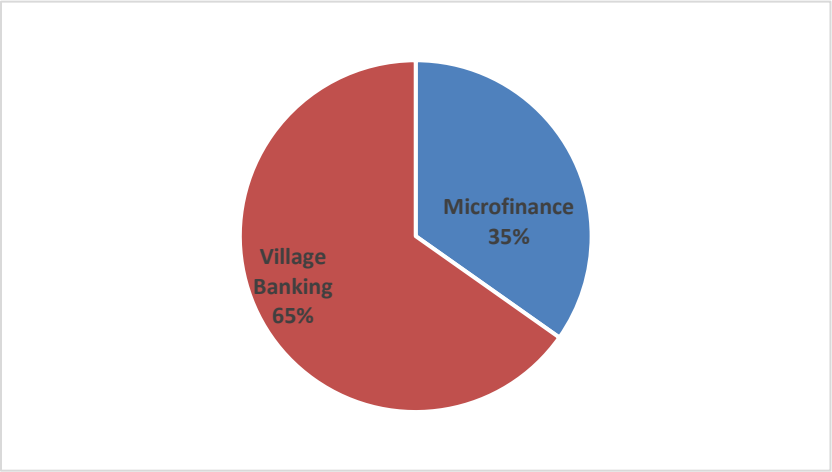

Figure 26: Sources of credit

Figure 27 shows the reasons for not accessing credit among the farmers

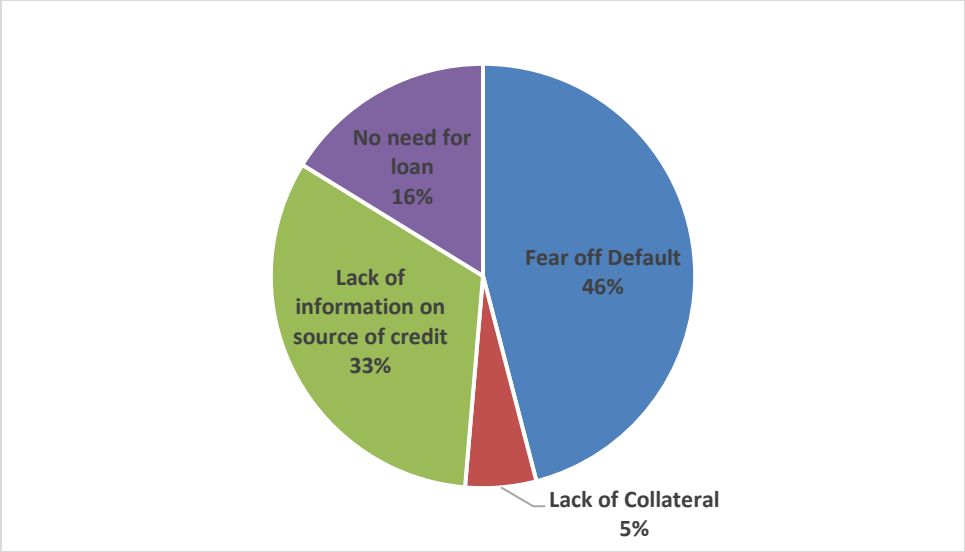

Figure 27: Reasons for not access credit

Non-Crop Farming activities

Figure 28 depicts the type of non-crop farming activities the tomato farmers engaged in the last 12 months and the proportion of farmers per activity.

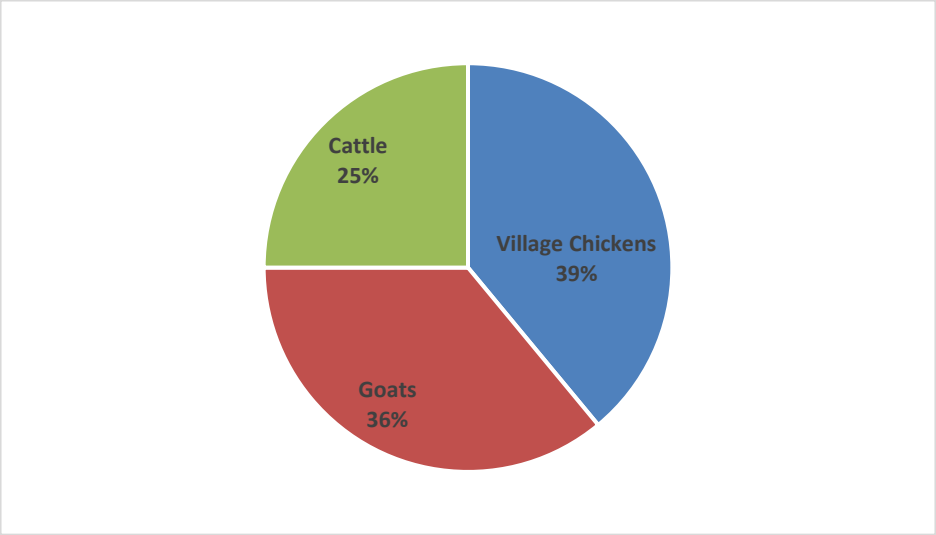

Figure 28:Types of Livestock reared by tomato farmers

Figure 29 shows the extent of non-crop farming activities among tomato farmers in the study area in the last 12 months

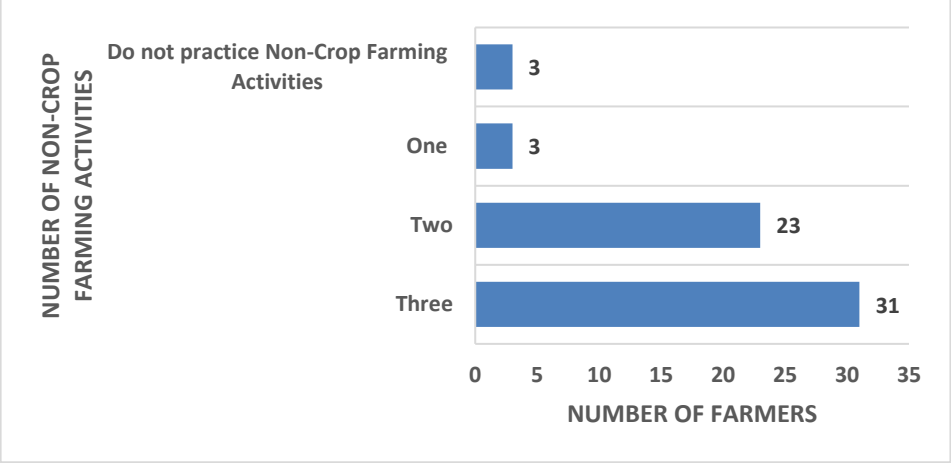

Figure 29: Extent of Non-crop farming activities among tomato farmers

The Figure 30 shows the number of farmers by farmer size who earned non-crop income in the last 12 months.

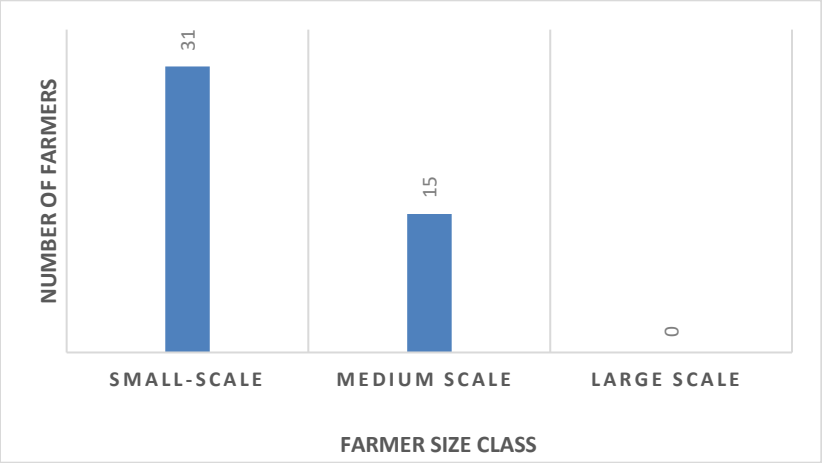

Figure 30:Number of tomato farmers who earned non-crop income

Off-Farming Activities

Figures 31 shows the frequency of farmers who practiced off-farm activities in the last 12 months.

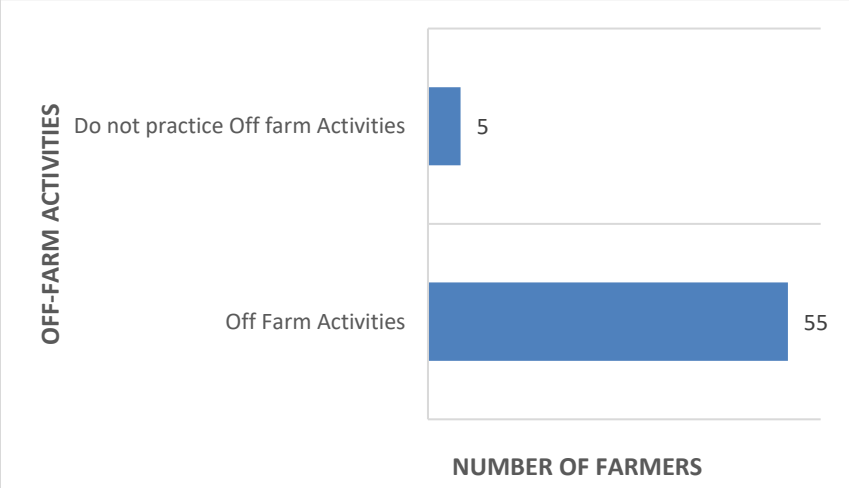

Figure 31: Number of farmers practicing off-farm activities

Off-Farm Activity Types

Figure 32 shows the types of off-farm activities practiced by farmers in the last 12 months.

Figure 32:Types of off-farm activities by tomato farmers

Figure 33 shows the number who earned income from off farm activities in the last 12 months

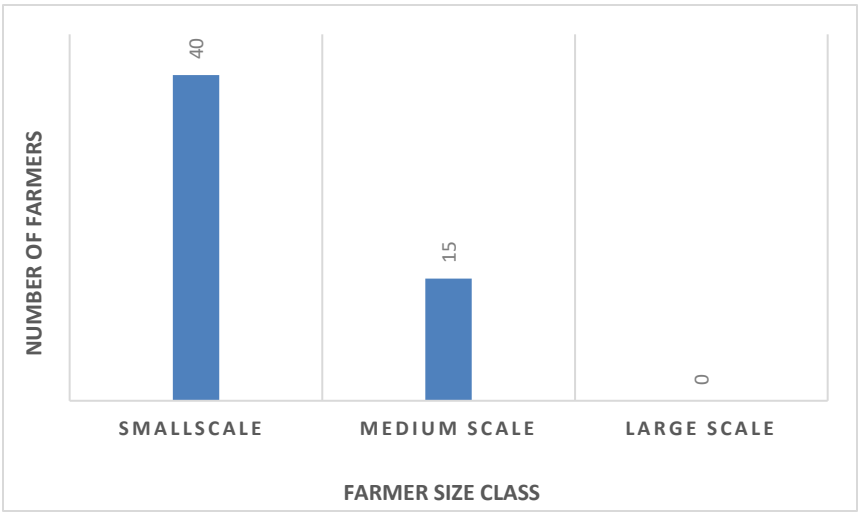

Figure 33: Number of farmers who earned off-farm income

4.1.3 Effectiveness of price risk management strategies employed by farmers

Irrigation

To assess the effectiveness of irrigation as a PRM strategy the number of months spent irrigating tomato was compared to the coefficient of variation of tomato market prices in the last 12 months. ANOVA showed a significant difference (p=0.032). The LSD showed that were significant differences in the coefficient of variation of price of tomato between farmers irrigating for zero to 2 months and those irrigating for 3 to 5 months and between farmers irrigating for zero to 2 months and those irrigating for 6 to 8 months. Figure 34 depicts these differences.

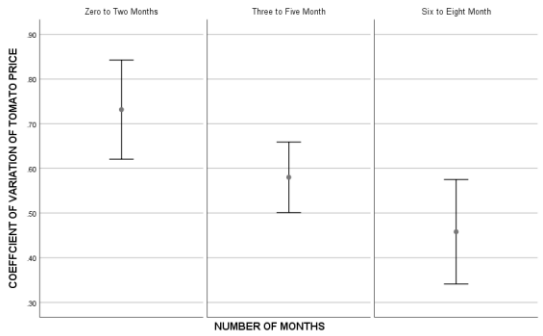

Figure 34: Coefficient of variation of price relative to months of irrigation

Variety Diversification

To assess the effectiveness of variety diversification as a PRM strategy, ANOVA of the coefficient of variation of price of tomato-based on the number of tomato varieties grown in the last 12 months was carried out. Farmers growing 3 to 4 varieties, had a smaller coefficient of variation in tomato price compared to farmers growing 1 to 2 varieties. The ANOVA was significant at p=0.073 at 10% significance. Figure 35 shows this depicts this difference.

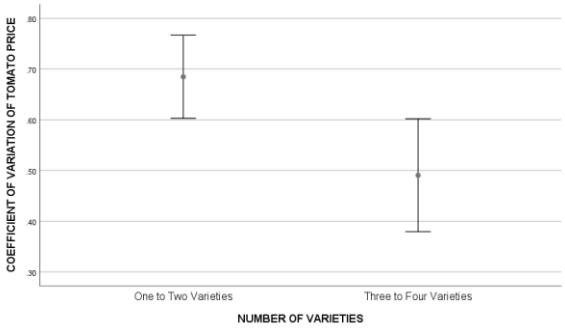

Figure 35: Coefficient of variation of tomato price relative to number of varieties

Crop Diversification

The ANOVA of income per hectare relative to the number of other crops showed that there were significant differences (p=0.008) in income per hectare relative to the number of crops. LSD showed significant difference to be existing between farmers growing one crop and those growing two, three, four and six crops respectively. The income per hectare showed a decreasing trend relative to the number of crops grown. Figure 36 depicts this difference.

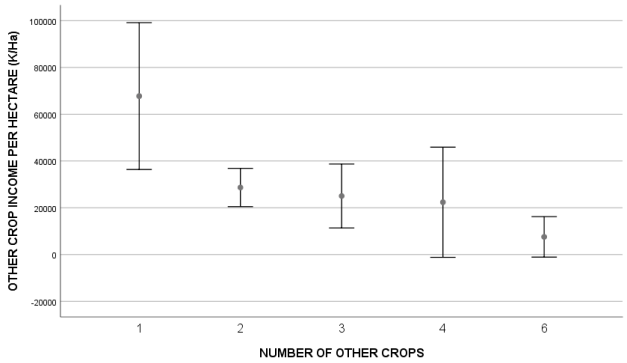

Figure 36: Income per hectare relative to number of crops

Non-Crop Income

The independent t-test showed that there are significant differences (p=0.006) income between farmers who earning non-crop income and those who did not earn non-crop income in the past 12 months. Figure 37 depicts this difference.

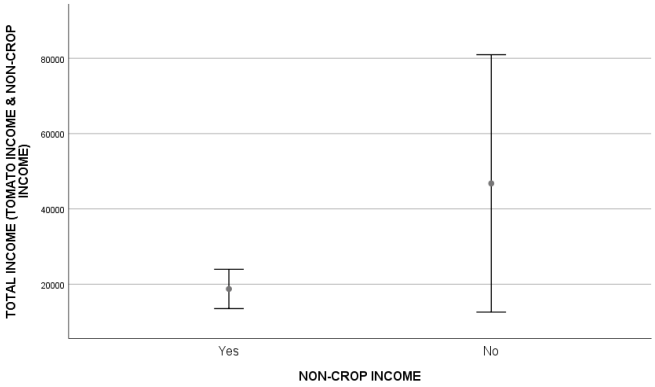

Figure 37: Comparison of total income of farmers who earned and did not earn non-crop income

Figure 38 depicts the difference in total income between small-scale farmers who earned non-crop and those who did not earn non-crop income in the last 12 months. The independent t-test showed significant differences (p=0.07) at 10% significance

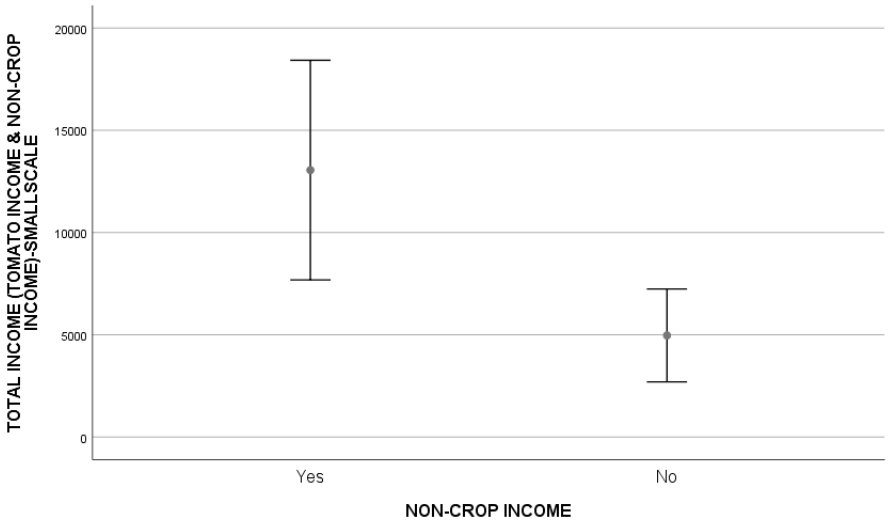

Figure 38: Comparison of total income Small-scale farmers earned and did not earn non-crop income

Off-Farm Income

Figure 39 depicts the independent t-test showing that there are significant differences (p=0.00) income between farmers who earned off-farm income and those who did not earn off-farm income in the past 12 months.

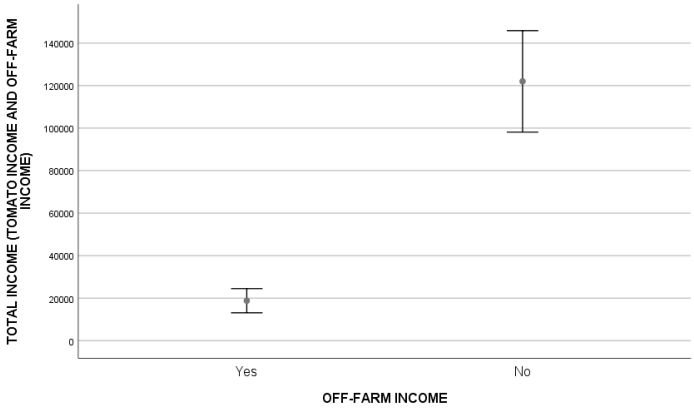

Figure 39: Total income of farmers who earned off-farm income and those who did not

Additional Analysis

Tables 2 and 3 show additional analysis that were carried out.

Table 2: Additional Analysis (Part 1)

Analysis	**Result**	**Test & Significance**
COV of price relative to the proportion of the area of land irrigated in the last 12 months	There were no significant differences coefficient of variation of price based on the proportion of the area of irrigated land	(COV) ANOVA; (p=0.545)
COV of the price of tomato relative on-farm grading in the last 12 months	The were no significant differences in COV of the price of tomato-based on-farm grading	(COV) Independent t-test: (p=0.316)
COV of price tomato based on access to business services (credit access & extension access)	▪ No significant differences in COV between farmers who access credit and those who did not ▪ No significant difference in COV between farmers who accessed extension services and those that did not. ▪ No significant differences in COV among farmers who accessed extension services at different times.	▪ (COV) Independent t-test; (p=0.218) ▪ (COV) Independent t-test; (p=0.343) ▪ (COV) Independent test; (p=0.252)

Table 3: Additional Analysis (Part 2)

Analysis	**Result**	**Test & Significance**
ANOVA of non-crop income as a proportion of tomato income by farmer size in the last 12 months.	Although small-scale farmers had higher non-crop income as a proportion of tomato income compared to medium and large-scale farmers, however, these differences were not significant	ANOVA; (p=0.127)
ANOVA of off-farm income as a proportion of tomato income by farmer size in the last 12 months.	There were no significant differences in off-farm income as a proportion of tomato income among the different classes of farmers.	▪ ANOVA; at 5% significance (p=0.073)
ANOVA of income from crop diversification based on the number of crops grown among small-scale farmers	No significant differences in income per hectare among small-scale farmers growing different number of crops.	ANOVA; (p=0.690)

4.1.4 Determinants of price risk management strategies decision

Chi-test was used to determine the factors that determine the choice of PRM strategies

a) Crop Diversification

As shown in Figure 40 the Chi-test showed a significant difference (p=0.01) in crop diversification among the different farmer sizes. Large scale farmers diversified less than both small and medium-scale farmers. This implies that in the last 12 months small-scale diversified more than the other two types of farmers.

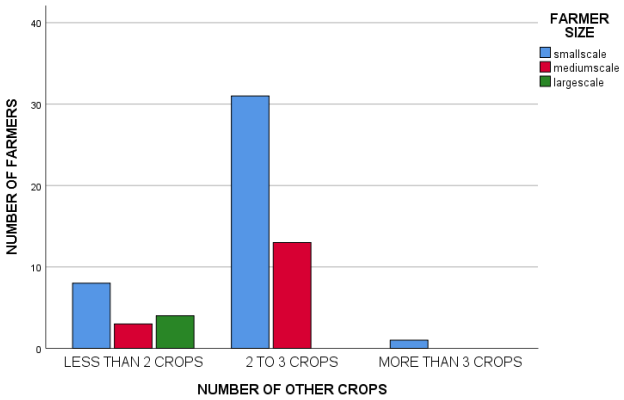

Figure 40: Difference in crop diversification based on farmer size

b) Irrigation

As shown in Figure 41 the Chi-test shows that more small-scale farmers irrigated for less than 3 months. Most medium-scale farmers tended to irrigate for less than 3 months. All large-scale farmers irrigated for more than 3 months. This shows that the larger the farm size the more the month spent on irrigation.

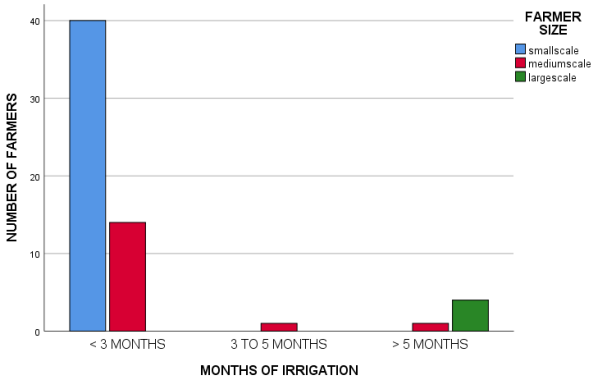

Figure 41: Difference in months of irrigation based on farmer size

C) Variety Diversification

As shown in Figure 42 the Chi-test shows that there were significant differences (p=0.00) in variety diversification among the three classes of farmers; small-scale, medium-scale, and large-scale in the last 12 months. The results show that more small-scale farmers grew 1 to 2 varieties compared to medium-scale farmers. All the large-scale farmers grew 3 varieties. The number of varieties is therefore inversely related to farm size.

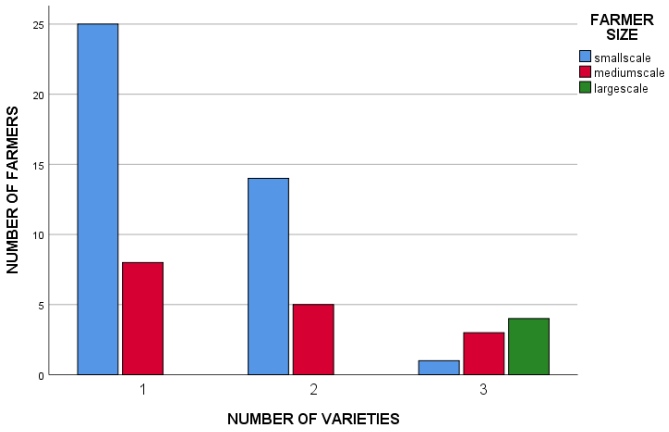

Figure 42: Difference in number of tomato varieties per farmer size

D) Credit Access

As shown in Figure 43, The Chi-test showed that there were significant differences (p=0.00) in credit access among males and females in the last 12 months. The results show that women took up more credit than men. This implies that in the last 12 months females were more likely to access credit for tomato production than males.

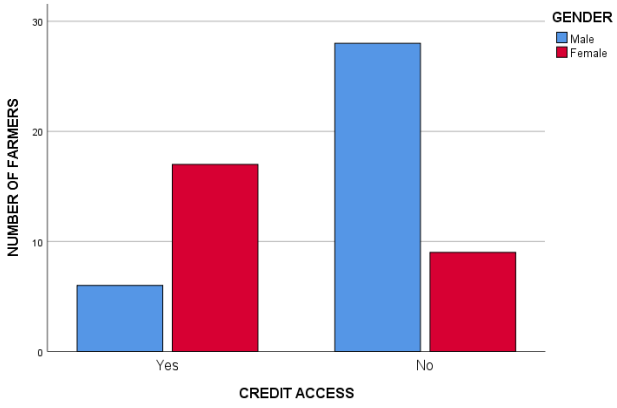

Figure 43: Difference in credit access based on gender

Additional Analysis

Table 4 shows additional analysis carried out by turned out.

Table 4: Additional Analysis

Analysis	Result	Test & Significance
Chi-Test of number of varieties on gender	There were no significant differences in the number of tomato varieties grown based on gender	p=0.825
Chi-Test of off-farm activities on gender	There were no significant differences between males and females based on engagement in off-farm activities	p=0.152
Chi-Test of non-crop activities based on gender	There were no significant differences between males and females based on engagement in non-crop activities	p=0.61
Chi-Test of number of varieties on gender	There were no significant differences in months of spent on irrigation based on gender	p=0.236

4.2 Findings from Expert and Key-Informant Interviews

A. Dimension 1: The current state of price risk management (PRM) strategies employed by small scale tomato farmers in Mwalumina Area.

a) PRM strategies employed by tomato farmers

According to five of the experts, PRM strategies currently employed by tomato farmers in the area include reducing costs when a price drop is anticipated, crop and variety diversification, irrigation and grading of produce even though the grade of tomato is almost always never considered at spot markets where the majority of tomatoes is supplied. In the case of large-scale farmers, the experts stated that all-year-round production was the main PRM strategy employed. Other strategies including income diversification activities like non-crop activities such as livestock rearing and off-farm investments. Although, the experts stated that off-farm investments are not as common as non-crop and crop diversification activities. One expert stated that farmers also practice variety diversification or crop staggering.

All the experts stated that no formal PRM strategies are being employed by small-scale farmers in the study area. According to the experts, some large and medium scale farmers practice formal PRM strategies like forward contracts (forward pricing) and contract farming with supermarkets. However, one expert stated that contracts to supply to supermarkets do not guarantee a stable price for producers. Five of the experts stated that currently, all forward contracts (forward pricing) in the tomato value chain are with wholesalers who supply to supermarkets or with supermarkets. Four of the experts also stated that a few large and medium-scale farmers practice contract farming. All the experts interviewed stated that there are no 'on-farm' value addition activities among all the three classes of farmers in the area.

b) Effectiveness of PRM strategies employed by tomato farmers

Four of the experts stated that crop and variety diversification are effective PRM strategies. Three of the experts stated grading as being an ineffective PRM strategy because grading is not a factor that is considered in pricing at spot markets like Soweto. Irrigation, non-crop income, and off-farm income activities are considered as not being effective because of the limited number of farmers practicing these activities in the study area. 'On-farm' value addition was stated as not being effective because it's not practiced in the study area although the experts stated that it would be an effective strategy if it were practiced. Three experts on the other hand stated that informal PRM strategies employed by farmers are largely ineffective because they are not based on market information.

c) Influence of business support services on PRM strategies employed by tomato farmers

Four of the experts stated that access to credit has a positive influence on tomato farmer's ability to offset the effects of price risk although farmers in the study area largely lack collateral and are therefore not able to access credit. In contrast, two key-informants stated that credit access does not influence farmers ability to cope with price risk as farmers are given credit to guarantee a supply of a specific quantity of produce in the future at prevailing market price; they also stated that credit access as a PRM strategy would only be effective under forward contract or contract farming arrangements. Three of the experts stated that extension service access had a positive influence on the farmer's ability to cope with price risk because farmers gain knowledge and skills on PRM strategies.

B. DIMENSION 2: Reorganization of the tomato value chain to alleviate the problem of price risk

a*) Formalized PRM strategies small-scale tomato farmers can adopt?*

According to experts, the formal PRM strategies that can be employed in the tomato value chain include forward contracts with supermarkets and processors. The experts also stated that no tomato farmers are supplying fresh tomatoes to processors on forward contracts. Two experts stated that with exception of one tomato processor all other tomato processors in Zambia are currently importing tomato paste from South Africa and China for manufacture into tomato sauce. The one processor processing tomato paste into tomato sauce is said to be sourcing directly from Soweto open market at prevailing market prices.

Seven experts also stated contract farming as a potential formal PRM strategy. Three key informants and four experts suggested the formation of tomato cooperatives and producers' groups as mechanisms to enhance farmer's bargaining power and reduce information asymmetry. Two key informants and three experts stated that credit access in form of cash and non-cash loans such as seed, fertilizer, chemicals, and crate hire can enhance farmer's ability to cope with risk. Two experts stated that market information systems such as Lima Links and Maano that provide a platform for trustworthy, open, and transparent virtual markets can reduce information asymmetry. Two experts stated commodity exchange and warehouse receipt systems as potential strategies provided cold storage facilities were availed.

b) Changes to the regulatory framework governing the tomato value chain to alleviate the problem of price risk

Eight of the experts stated that there is currently no specific regulatory framework governing the tomato value chain. They also stated that there is currently no regulation governing the activity of brokers in open markets. Two experts stated that the absence of regulations governing broker behaviour in markets allows for an atmosphere of mistrust and lack of pricing transparency. Brokers charge hidden commissions or 'tubende' that distort prices. The experts also stated that the current Markets and Bus stations Act (2007) does not take into account the operation of fruit and vegetable wholesale and retail markets. Four experts suggested regulations compelling

processors to source tomatoes locally under contract with farmers. Although, they stated that in a liberalized economy there is a limit to regulation on economic activity. However, according to experts, regulations that protect producers and other actors in the chain from exploitation and information asymmetries are important for the sustainability of the tomato value chain.

c) Changes to the governance of the tomato value chain to alleviate the problem of price risk

Experts and key informants stated information asymmetry between supply and demand-side actors was a major problem as producers largely had no access to market information. They also stated the lack of coordination and cooperation in the chain because of the 'market type' of governance predominating the traditional sector of the tomato value chain. Seven experts suggested captive and modular governance systems in the form of contract farming and forward contracts respectively. Seven experts stated that cold storage facilities at wholesale markets like Soweto are non-existent making it difficult to regulate the inflow and outflow of tomato produce resulting in dramatic price swings. The experts suggested setting up cold storage facilities to allow for the storage of tomato in case of oversupply. One expert suggested on-farm processing of tomatoes to reduce post-harvest losses. One key-informant stated that farmers need to have Global-GAP certification to be able to secure supply contracts. Another key informant stated the need for farmers to improve the quality of tomato produce. One key-informant stated that they only accept tomato with the required quantity of solids (38% BRIX). One expert proposed Public-Private Partnership's (PPP's) in fresh fruit and vegetable markets, unlike the current situation where all control is under councils. Another expert stated the need for agricultural financing to help farmers access credit to invest in improving quality and cold storage infrastructure.

d) Inclusion factors before small-scale tomato farmers can adopt do formal (PRM) strategies

For small-scale farmers to be able to take up formalized PRM strategies seven experts stated that farmers need education on production technologies including produce and process quality (Certification/HACCP/SOP/MRLs) and water quality testing (E. coli and coliform tests). Two experts stated the need for improved trust and commitment to honour contracts among small-scale farmers as most farmers are known to abrogate contracts and most supermarkets and processors are unwilling to sign contracts with small-scale farmers. Three experts stated that small-scale farmers lack bargaining power and as such there's a need to increase bargaining power among small-scale through producer group or cooperative formation for farmers to negotiate for fairer prices. Seven experts stated the need to ensure consistency of supply quantities as most small-scale farmers cannot individually fulfill the required supply quantities under contracts. Two experts suggested the need for improved financing among farmers through improved access to credit and by pooled collateral in form of cooperatives or producer groups.

4.3 Focus Group Discussion

Preference ranking was used to rank and score the informal PRM strategies in terms of effectiveness and formal PRM strategies in terms of preference. The scores for the two groups were consolidated to derive the overall ranking of the PRM strategies.

Scoring of Informal PRM Strategies

The farmers scored crop diversification followed by non-crop activities and off-farm activities as the most effective strategies. Farmers rated irrigation as being the least effective PRM strategy. Figure 44 shows the cumulative score of the two FGD groups for informal PRM strategies.

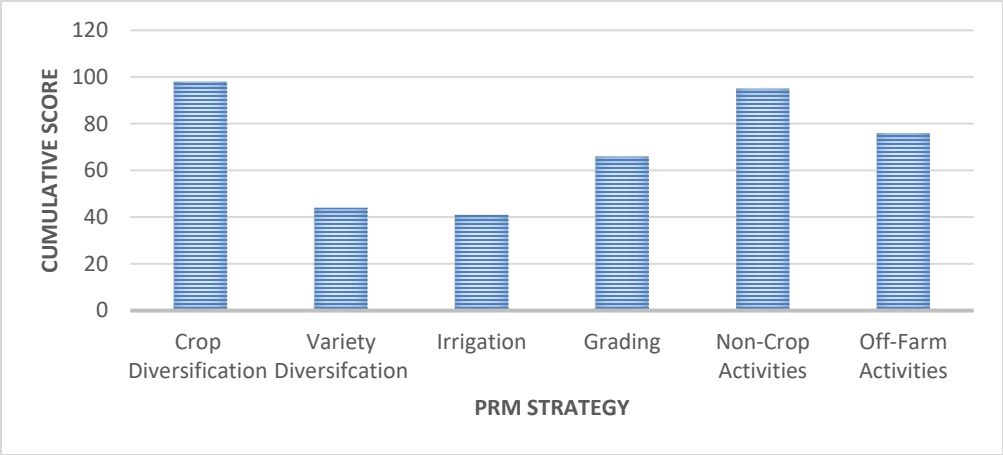

Figure 44: Cumulative score of informal PRM strategies

Scoring of Formal PRM Strategies

The farmers scored contract farming, followed by forward contracts and cooperatives as their most preferred strategies. The farmers rated commodity exchange as the least suitable PRM strategy for them. Figure 45 shows the cumulative score of the two FGD groups for the formal PRM strategies.

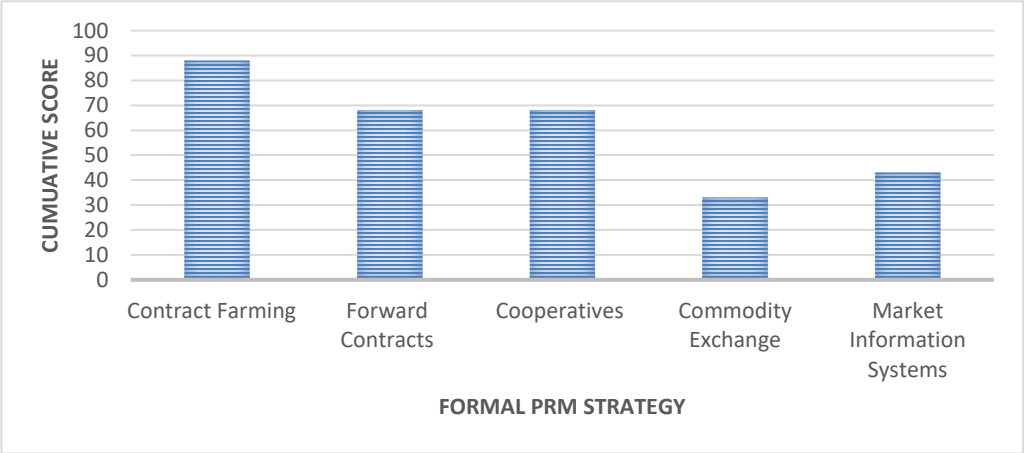

Figure 45: Cumulative score for Formal PRM strategies

Table 5, depicts the SWOT-PEST Analysis Matrix. The SWOT-PEST matrix has been used to explore the constraints and opportunities for small-scale tomato farmers in the tomato value chain in Mwalumina Area.

Table 5: SWOT-PESTEC Analysis Matrix

SWOT-PESTEC MODEL		*Political*	*Economic*	*Social*	*Technological*
INTERNAL FACTORS	***Strength***	• Government policy of economic diversification • Good road network	• High demand for fresh tomatoes • Demand for processed tomato products	• Vicinity to markets	• Access to phones
	Weakness	• Weaker property right among women	• Seasonal production • Low bargaining power • Lack of collateral	• Small farm size • Subsistence farming	• Limited production knowledge • Limited extension services • Inefficient irrigation technologies • Low entrepreneurial skills
INTERNAL FACTORS	***Opportun***	• Public-private partnerships • Presence of export market	• Forward contracts • Contract farming • 'On-farm' processing of tomato	• Increasing population • Urbanization	• Favourable climate
	Threats	• Lack of regulatory framework governing broker activity • Limited private sector investment	• Price variability at spot markets • Hidden commission • Lack of transparency in pricing	• Lack of cooperation and coordination in the chain	• High information asymmetry • Absence of certifications • Limited extension services • High pest & disease incidence

CHAPTER FIVE

5.0 DISCUSSION

The purpose of this chapter is to interpret and describe the significance of the research results in the context of the research problem and to explain the insights gathered from experts and key informants to answer the research objective.

5.1 Socio-economic characteristics of the sample

The survey sampled 40 small-scale, 15 medium-scale, and 5 large-scale farmers. The study found that majority of respondents were males. The majority of respondents had primary level of education followed by secondary and basic education. The least number of respondents had college level of education, according to (CSO/MAL/IAPRI, 2015) 50 percent of households involved in agriculture in Zambia have primary level of education. The mean age of the tomato farmers was 42 years, according to (CSO/MAL/IAPRI, 2015) the mean age of small-scale farmers in Zambia is 48 years. This indicates that few youths are involved in tomato production, this could be a result of resource constraints barring youth from entering into agricultural activities. According to Sichone and Kwenye (2018), youth participation in agriculture is constrained by a lack of capital and technical assistance. The mean age of 42 is lower than the Lusaka Province average age of 50 years (CSO/MAL/IAPRI, 2015). The results also showed that the mean farming experience was 9 years. The mean household size was 8 persons per household compared to the Lusaka province average of 6 (CSO/MAL/IAPRI, 2015). The mean hours to market was 3 hours, indicating that farmers are in the vicinity of the open market. As such, distance to market should not be a factor in post-harvest losses in the area. Tadessa et al. (2018) state that distance to markets is a factor that contributes to post-harvest losses for fresh produce. The mean proportion of the area of land devoted to tomato production was 22%, this proportion is bigger than the provincial average of 2% (CSO/MAL/IAPRI, 2015).

5.2 Price Risk Management Strategies employed by tomato farmers in the Study Area

The study found that all of the tomato produce from the respondent farmers is sold fresh in spot markets in the city or to mobile traders who export to the neighbouring DRC. None of the farmers in the area is employing formal PRM strategies to cope with the price risk of tomato produce in markets. Experts also stated that no formal PRM strategies are being used by farmers in the study area. Taylor et al. (2009), stated that farming in Zambia is characterized by the absence of formal PRM strategies and that where these are available, they are too costly for the average farmer. This means that farmers are largely at risk of price variability of tomato produce at spot markets. Table 6 depicts the business canvas of tomato farmers in the study area. The business canvas shows that the tomato farmers in Mwalumina area practice ad-hoc spot marketing of tomatoes. The farmers have no control over the pricing of their produce. The canvas also shows that the farmers are operating as chain actors in the chain. The Triple Bottom Line shows that tomato production by farmers in Mwalumina is not a sustainable venture.

Table 6: Current business canvas of tomato farmers in Mwalumina Area

<table>
<tr><td>Key partners
▪ MAO
▪ MCTI
▪ City Council</td><td>Key Activities
▪ Tomato cultivation
▪ On-Farm size grading
▪ ‘Spot market’ tomato marketing
▪ Supply of tomato produce to traders for export (DRC)
▪ Other vegetables (Diversification)</td><td rowspan="2">Value proposition
▪ Fresh Tomato
▪ Sized graded tomato
▪ Inconsistent supply of produce
▪ Poor quality</td><td>Customer Relationship
▪ Lack of cooperation & coordination
▪ High level of mistrust
▪ Hidden commissions
▪ Lack of pricing transparency</td><td rowspan="2">Customer Segments
▪ Retailers
▪ Traders</td></tr>
<tr><td>Partners Provide
▪ Extension services support
▪ Farmer training schools
▪ Business environment
▪ Crop levies</td><td>Key Resources
Physical
▪ Traditional land
▪ Farming implements
▪ Oxen
Human
▪ Household labour
Financial
▪ Reinvesting income from tomato sales
▪ Credit (Micro)
▪ Village saving</td><td>Marketing Channel
▪ Brokers
▪ Farmgate</td></tr>
<tr><td colspan="3">Cost structure
▪ Seedlings
▪ Chemicals (Pesticides, herbicides, adjuvants & Fertilizers)
▪ Labour (Land preparation, irrigation sowing, mulching, weeding, pruning, staking, spraying, harvesting, grading)
▪ Rent of Crate
▪ Transportation</td><td colspan="2">Revenue streams
▪ Tomato sales
▪ Other Income (Other crop sales)
▪ Non-crop Income (Livestock and livestock product sales)
▪ Off-Farm Income</td></tr>
<tr><td colspan="5">Sustainability
People: Low level of youth participation, high unemployment, poverty
Profits: Unstable income., low incomes
Planet: High post-harvest losses, high greenhouse emissions</td></tr>
</table>

Figure 46 depicts the tomato value chain in Mwalumina area mapped using data from the household survey and expert and key informant interviews. The chain map shows that the tomato from farmers is supplied fresh to the open market and traders for export to the DRC. The tomato is sold to retailers via brokers who charge a commission for their services. There are no supermarkets or processors in the value chain. This is consistent with Tschirley & Hichaambwa (2010), who stated that the traditional sector of the tomato value chain does not have supermarkets and processors but is dominated by open markets.

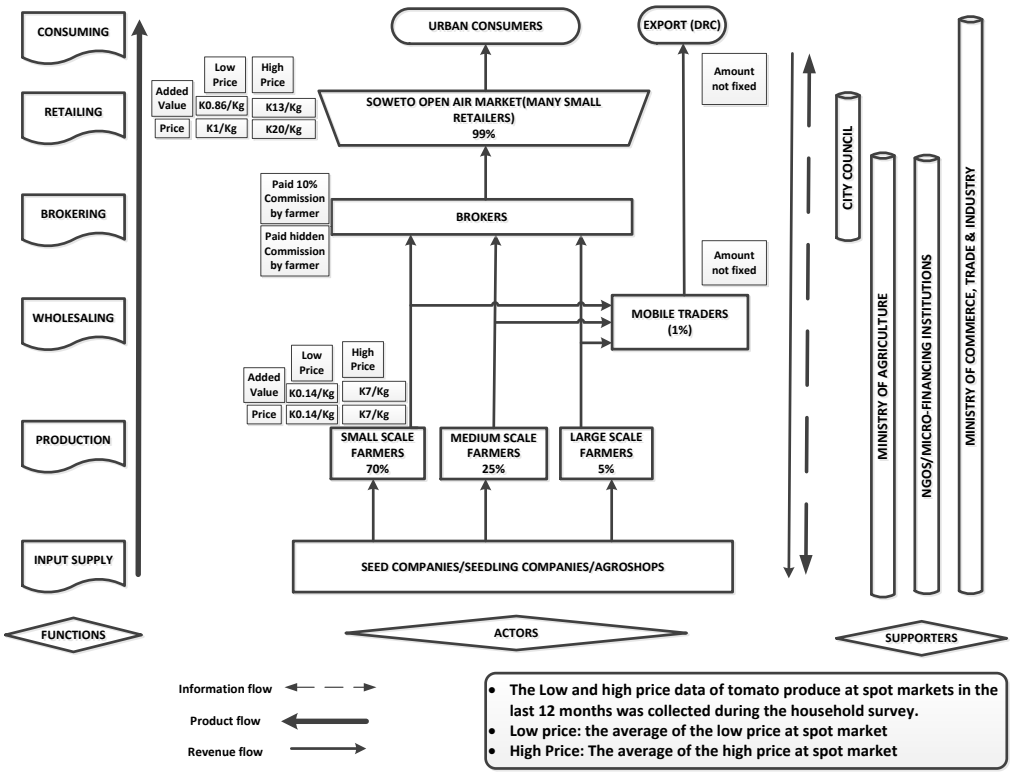

Figure 46: Tomato Value chain map in Mwalumina Area

Tangermann (2011), stated that farmers like most entrepreneurs have an array of informal options for managing the risks they face including planting drought-resistant crops, investing in irrigation facilities, and income diversification in the form of on-farm and off-farm income. Tangermans's views are similar to the situation in Mwalumina area where farmers employ strategies such as crop and variety diversification, irrigation, non-crop, and off-farm activities. Experts stated that in addition to these strategies small-scale farmers reduce their cost when they anticipate a price drop. Large scale farmers on the other hand produce all year round and benefit from the average price of the year. This is consistent with results from the household survey that showed that all farmers produce tomato all year round.

Figure 47, depicts a chain matrix showing that tomato farmers in Mwalumina are chain actors with the absence of vertical and horizontal integration activities. Farmers do not engage in other activities in the chain and do not manage any aspect of the tomato value chain. There is limited coordination and cooperation between farmers and other actors. Farmers lack market information and have no bargaining power to negotiate for higher and stable prices.

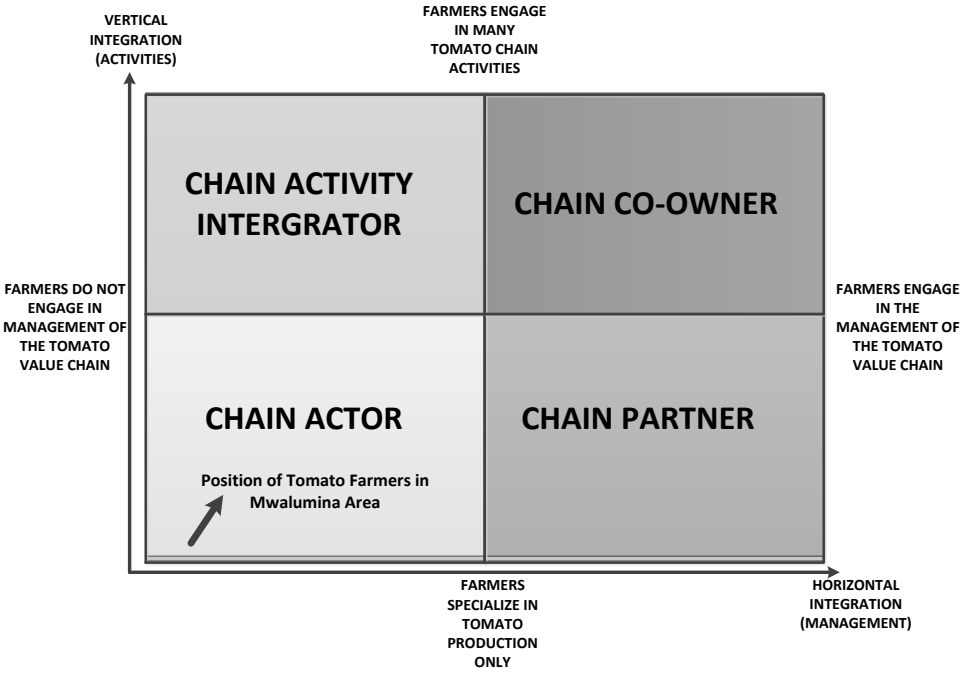

Figure 47: Chain Matrix of Tomato farmers for Mwalumina

Crop diversification and irrigation were the predominant PRM strategies employed by the farmers in the last 12 months. Makate et al. (2015) found that 81 percent of small-scale farmers in Zimbabwe practice crop diversification. Peter (1991), found that crop diversification is one of the most common means by which farmers attempt to stabilize agricultural income. Large scale farmers grew only one crop in addition to tomato but for a longer number of months than medium and small-scale farmers. This could be because large scale farmers view farming as a business and are inclined to focus on growing few crops but on a larger scale. These results are in contrast to the findings of Makate et al. (2015) who found that a one-acre increase in land size was found to be associated with a 15.8 increase in the probability to adopt crop diversification. Larger farmers are more likely to diversify than smaller farmers.

In the last 12 months, the mean of the proportion of land under irrigation for large scale farmers was 100 percent. Large-scale farmers also irrigated their tomato for more months than medium and small-scale farmers. This could be because of access to more sophisticated irrigation equipment compared to small-scale farmers who use cheap, inefficient, and unsophisticated irrigation equipment. According to Tschirley et al. (2019), in Zambia, 100 percent of tomato farmers practice irrigation compared to only 20 percent for maize farmers. He further stated that households selling tomato into the urban market use irrigation at much higher rates than other small-scale farmers. In contrast, AGBIT (2015) found that 1 of 20 smallholder farmers engaged in horticulture in the Mumena area of Solwezi had access to drip irrigation. AGWATER (2011), in their findings on the extent of among small-scale horticulture farmers, found that only 20% of small-scale farmers in Zambia engage in irrigation.

Results show that 50 percent of the farmers practiced variety diversification in the last 12 months. Large scale farmers grew more varieties than small and medium-scale farmers. According to Peter (1991), cultivating varieties with varying maturities permits staggered plantings which spread the risk of loss due to period-specific stress such as drought. By staggering their tomato, crop farmers spread out the harvest period. Large scale farmers grew more varieties of tomato and practiced variety diversification for more months than small and medium farmers.

This can be attributed to large-scale farmer's attitude of focusing on tomato as a business and growing all year-round and thus benefiting from the average price. According to Hassan & Nhemachena (2008), larger farm sizes were found to encourage the use of multiple cropping and allow farmers to diversify their crop options and help to spread the risks of loss associated with changes in climate. According to Hassan & Nhemachena (2008), the availability of labour may be a critical factor constraining crop diversification as such the comparatively higher labour availability larger farmers were more diversified.

None of the respondent farmers had access to cold-storage facilities in the last 12 months. This is could be primarily due to the high cost of cold storage facilities. The lack of cold storage facilities means that farmers do not wait for long after harvesting to take their produce to market. This also means that post-harvest losses may be a problem among farmers in the area. According to Hichaambwa and Tschirley (2010), there are no cold storage facilities in the traditional sector of the tomato value chain in Zambia. The absence of cold storage facilities means that farmers have to take produce to markets as soon as they harvest to avoid losses. This also entails that farmers are forced to sell at lower prices. Maheshwar and Chanakwa, (2006) stated that the lack of cold chain infrastructure for vegetable crops entails that farmers cannot store produce for long periods and often sell immediately after harvest. As a result, prices are subject to wide fluctuations and farmers are often unable to get remunerative prices for their crops.

None of the respondent farmers was a member of a tomato cooperative. Experts stated that there are no tomato producer groups or cooperatives in the area. This is a general trend across rural areas in the country as the government policy architecture predominantly favours maize. Almost all cooperatives in the crop subsector are primarily paired to the Farmer Input Supply Programme (FISP) for maize production which is Zambia's staple crop. According to FAO, (2020), cooperatives are viewed as rural mobilization tools for maize inputs rather than agricultural development tools and business organizations. By not be organized in cooperatives or groups, farmers do not take advantage of benefits associated with cooperatives such as increased bargaining power and reduced transaction cost. According to Manda et al. (2020), cooperative membership tends to reduce transaction costs in accessing output markets.

The majority of farmers practiced fruit size grading in the last 12 months. However, experts' opinions were that the farmer cannot bargain for a higher price based on the quality of their produce at spot markets. This is in contrast to Asgedom et al. (2011) who stated that in Eritrea that there are significant price differences based on the size grade of tomato at spot markets with price difference as much 50 to 75 percent between the first and second grades.

In the last 12 months, none of the farmers practiced 'on-farm' processing of tomato. Expert's stated that by not venturing into 'on-farm' value addition the farmers lose out on a price risk tool that can help them realize higher prices for their produce and reduce post-harvest losses. The problem of lack of on-farm processing activities among the farmers may be exacerbated by the absence of tomato cooperatives. Cooperatives can allow for resource and collateral pooling to facilitate for procurement of processing equipment. Tripathi et al. (2017) whose research on the impact of the value-added tomato-based product for income generation of farm women, found that there was an increase in gross profits by 22.95 percent from the processing of tomato. They also stated that on-farm processing can be helpful as a tool against market price fluctuation and post-harvest losses.

In the last 12 months, only 50% of the farmers sampled accessed extension support. The government was the only provider of extension services. Extension services support can enhance access to information on more efficient production methods and technologies to enhance productivity and cope better with price risk. According to AGBIT, (2015), one of the major constraints to the horticulture sector is limited extension support. Extension support favours maize production which is the staple crop of the nation.

In the last 12 months, less than 50% of the farmers accessed credit. The major source of credit was village banking. Village banking is an informal and community level lending mechanism. According to (CSO/MAL/IAPRI, 2015) only 6% of farmers in rural areas in Lusaka Province have access to credit. (CSO/MAL/IAPRI, 2015) further state that among the eleven sources of credit among farmers, informal money lending is one of the most common sources of credit for farmers in all the provinces of Zambia. Farmers who can't access credit are unable to access the resources required to invest in income diversification activities that allow them to spread their risk. Hassan and Nhemachena (2008), state that better access to credit services seems to have a strong positive influence on the probability of adopting all adaptation measures and abandoning relatively risky monocropping systems. The fear of default because of the price variability of tomato was the major reason put forth by those who did not access credit. Other reasons included no need for a loan, a lack of collateral, and a lack of information on sources of credit. According to Louw (2007), access to credit is one of the biggest challenges faced by small-scale tomato farmers in South Africa and that the inability to access credit meant that small-scale farmers fail to participate in the value chain in the subsequent seasons because of liquidity problems.

In the last 12 months, the majority of the farmers practiced non-crop activities involving cattle, goat, and village chicken rearing. Medium-scale farmers had the highest proportion of farmers that earned an income from non-crop activities in the last 12 months. All the medium and small-scale farmers practiced off-farm income-earning activities in the last 12 months. Given their higher susceptibility to price risk, small-scale farmers, try to off-set this risk by allocating their resources to different enterprises covering some crops and livestock enterprises. This is a typical picture as small-scale farmers tend to grow for subsistence and are inclined to invest off-farm as a safety gap measure. However, large and medium scale farmers consider tomato farming as a business and are thus more inclined to focus on growing crops all year round. Gwebu and Matthews (2018) in their meta-frontier analysis of large and small-scale tomato production in South Africa in South Africa found that off-farm income was positively and significantly related to technical efficiency. Farmers who had off-farm income were more technically efficient than those with no off-farm income. The further stated that farmers with off-farm income were more easily able to buy inputs. According to Teshome & Edriss (2013), households with larger farm sizes require more time to cultivate, and as such farmers with large-scale, farmers tend to involve more in farming activities than diversification activities.

5.3 Effectiveness of Informal PRM Strategies

The results showed that in the last 12 months, the more the months spent on irrigation the less the coefficient of variation of tomato price. Because large and medium scale farmers irrigated for more months than small-scale farmers, large and medium scale farmers had a comparatively lower coefficient of variation of price for their tomato produce. This is an indication that irrigation had a positive effect on the farmer's ability to cope with price variability of tomato produce. In their study, Foudi and Erdlenbruch, (2012), found that irrigating farmers have higher means, lower variances, and less negative skewness on profits than non-irrigating farmers. A comparison of means of the coefficient of variation of tomato price based on the area of irrigated land, however, showed no significant differences. Significant differences in the coefficient of variation of price of tomato were attributed to months spent on irrigation rather than the area of irrigated land. The reason for this is that months spent on irrigation tend to spread out the period of harvest allowing the farmer to benefit from the average price across the harvest period while the area of irrigated land does not. In the FGD participants rated irrigation as the least

effective strategy, this could because the majority of the participants were small-scale farmers who irrigated for the least number of months.

Farmers growing more varieties of tomato had a lower coefficient of variation of tomato price. Large-scale farmers grew more varieties of tomato and for a longer number of months compared to both medium and small-scale farmers. Large scale farmers thus had a lower coefficient of variation of price of tomato in the last 12 months. This is an indication that variety diversification had a positive effect on the farmer's ability to cope with price variation of tomato produce. According to experts, variety diversification is an effective PRM tool among tomato farmers. Di Falco (2007) stated that variety diversification enhances productivity and can reduce yield variability and is therefore an important farm strategy for managing production risk. Di Falco, (2007) also found that variety diversification strongly increases expected revenues and can reduce the cost of risk. Large scale farmers may have benefitted from relatively sophisticated irrigation equipment allowing them to grow more tomato varieties. In the FGD farmers scored variety diversification as the second least effective PRM strategy after irrigation, this could be because the majority of the respondents in the FGD were small-scale farmers who did not practice variety diversification. The coefficient of variation of tomato price based on 'on-farm' grading, access to credit, and access to extension services did not show any significant differences.

In terms of crop diversification, results show that farmers who focused on growing one crop in addition to their tomato crop were found to have a significantly higher income per hectare than farmers who grew more crops. Large and medium-scale farmers grew fewer crops compared to small scale farmers growing. Large and medium-scale farmers, therefore, had a higher income per hectare from crop diversification than small-scale farmers. This could be explained in terms of the scale of operations as large-scale farmers have comparatively large pieces of land. Despite growing fewer crops, large scale farmers earned more income from relatively large pieces of land compared to small-scale farmers growing more crops but on smaller pieces of land. This is in contrast to Basantaray and Nanchariah (2017) who found that both average gross and net returns from crop diversification were significantly higher for those who were more diversified than those who were less diversified. A comparison of small-scale farmers based on income per hectare from crop diversification showed no significant differences. Crop diversification is an effective strategy for improving household income but small-scale farmers may not be able to fully exploit the benefit of crop diversification because of the smaller scale.

A comparison of farmers who earned non-crop income with those that did not shows that those who earned non-crop income had lower total income than those who did not. The situation was the same for off-farm income. This could be because almost all the farmers that did not earn non-crop and off-farm income were large scale farmers. The scale of tomato production implied that the income from tomato alone for large scale farmers is larger than the total income of small and medium farmers drawn from the sum-total of their income diversification activities. However, non-crop and off-farm income as a proportion of tomato income were highest for small-scale farmers indicating that they benefited more from non-crop and off-farm income activities compared to medium and large-scale farmers. This researcher argues that farmers earning off-farm income are better than those who did not. This view agrees with Gwebu and Mathews (2018) that in South Africa for both small- and large-scale farmers off-farm income was positively and significantly related to technical efficiency at ($p=0.01$) and that off-farm income increased the chance of farmers to easily and timeously buy inputs. Ibekwe et al. (2010) stated that the coefficient for farm size was significantly and negatively correlated with non-farm income. This entails that large-scale farmers will tend to focus on farm income compared to small-scale farmers. This also entails that an increase in farm size will encourage farmers to increase their farm output and farm income. In the FGD participants rated non-crop and off-farm activities respectively as the second and third most effective PRM strategies.

A comparison of total income among small-scale farmers who earned non-crop income and those that did not shows that those farmers who earned non-crop had significantly more income than those who did not earn an

income. Barrett et al. (2001), found that income diversification was associated with higher income realizations in contrast to households that do not practice income diversification.

5.4 Determinants of PRM strategies among tomato farmers

The socio-economic determinants that influence the choice of PRM strategy among farmers were analyzed. The socio-economic factors tested include age, gender, education, household size, farm size, farming experience, credit access, and extensions access. Only significant relationships are discussed.

Results show that there was a significant association between farmer size and the number of crops. More small-scale farmers grew more crops than the medium and large-scale farmers. Small scale farmers are more likely to grow more crops than other farmers. According to Gupta and Tewari (1985), larger farmers are less diversified than smaller farmers. This shows that there a negative relationship between farmer size and crop diversification. Farmers with small areas of land diversified more than farmers with larger areas of land. However, in contrast, Sichoongwe et al. (2014) found that land size increases the probability that a farmer will engage in crop diversification. Ashfaq et al., (2008), also stated that the more access to land that a farmer has the more they'll engage in crop diversification.

Results show that there was a significant association between the number of months of irrigation and farm size. Larger farmers were more likely to irrigate for more months than medium and small-scale farmers. This could be as a result of access to more sophisticated irrigation technologies. According to Afrakhteh et al. (2015), farm size had a positive relationship with irrigation mostly due to more efficient irrigation systems in medium and large farms.

There was a significant association between farm size and variety diversification. Large scale farmers were more likely to grow more varieties than medium and small-scale farmers. The larger the farmer the more the likelihood of engaging in variety diversification. This could be explained in terms of the attitude of large farmers of viewing farming as a business rather than a subsistence. Larger farmers are inclined to diversify tomato varieties to ensure all-year-round production compared to smaller farmers that tend to grow one variety and anticipate prices at markets. According to Hassan & Nhemachena (2008), larger farm size was found to encourage the use of multiple cropping and to allow farmers to diversify their crops and spread the risk.

There was also a significant association between gender and access to credit. This means that in the last 12 months more women accessed credit for tomato production than men among the respondents. This could be because females farmers have less access to productive resources and as such borrow to be able to engage in productive activity. This is in contrast to Ololade and Olagunju (2013) who stated that being a female reduces the probability of having access to credit. However, Peprah (2013) states that women are more likely to access credit than men.

The study also found that there were no significant differences in the number of tomato varieties grown based on gender. There were also no significant differences between males and females based on engagement in off-farm activities. There were no significant differences between males and females based on engagement in non-crop activities. There were also no significant differences in months of spent on irrigation based on gender.

5.5 Formal PRM strategies for small-scale tomato farmers

According to expert opinions, interventions to empower small-scale tomato farmers to be able to cope with the price risk entails both vertical and horizontal integration of farmers in the tomato value chain. According to KIT,

(2006), to improve the position of farmers in the chain we can either work on improving the farmer's chain activities or on the farmer's involvement in the management of the chain. The horizontal movement of farmers in the chain can come through the building of formalized market institutions. According to expert's horizontal movement can take the form of forward contracts with supermarkets and processors. Forward contracts can guarantee more stable prices than spot marketing. According to Kahan (2008), forward contracts are agreements that are based on an exchange of produce at a specified future time and allow farmers to establish a price for later delivery. In the FGD, participants scored forward contracts second after contract farming in terms of their preferred strategy. Formalized market institutions can also take the form of commodity exchanges. According to FAO, (2016), Commodity exchanges provide a centralized marketplace, simplify title transfers, perform the "price discovery" mechanism, and deal with price risks and market uncertainty. However, In the FGD participants rated commodity exchange as the least preferred formal PRM strategy.

Other forms of horizontal movement can also take the form of market information systems (MIS) such as lima links that reduce information asymmetry and allow for transparent, open, and trustworthy markets. According to Antonaci, et al., (2014) MIS are instrumental for farmers as they create a transparent environment that reduces marketing risks including price risk. AGBIT, (2015) stated that market information system address information flow and communication constraints. Market information systems would empower farmers with information about whether to take their produce to a particular market, enter prior deals before they transport their produce to a market of their choice, and save on transport costs that they incur when they move produce speculatively to the market. In the FGD, farmers scored MIS as the second least preferred formal PRM strategy. Figure 48 depicts the market interaction matrix for tomato in Mwalumina Area and shows the horizontal and vertical movement required for them to alleviate the problem price risk of tomato produce.

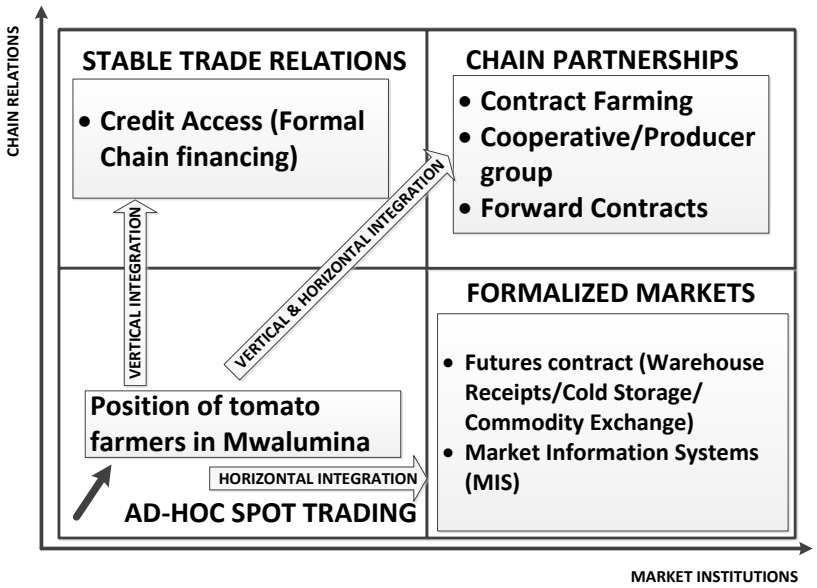

Figure 48: Market Interaction Matrix for Mwalumina Area

Vertical integration of farmers in Mwalumina can take the form of contract farming. According to Kharallah and Kirsten (2001); Stefanson and Fulton (1997), the increased need for vertical coordination and value chain management create a potential new role for contract farming as a way to link small farmers to high-value markets in the wake of market liberalization in developing countries. Louw and Jordan, (2016) who stated that formalized

relationships such as contracting are an inherent tool to manage specific dimensions of risk in the fresh produce value chains. However, Key and Runsten, (1999), argue that contract farming has high per-unit costs of contracting with small-scale-farmers as they have greater problems in meeting stringent quality and safety requirements and therefore agribusinesses favour contracts with medium to large scale farmers. However, in the FGD, contract farming was scored as the most preferred strategy by the participants.

Vertical integration can also involve the formation of cooperatives or producer groups. Louw and Jordan, (2016), stated that farmers receive risk management support from cooperatives or producer groups in form of funding and input and extension support. It's easier for farmers organized in cooperatives to access funding from the government and credit institutions. Louw and Jordan, (2016) also stated, that cooperatives help to reduce transaction costs of selling produce at markets. In the FGD, participants rated cooperatives as the third most preferred formal PRM strategy.

Vertical integration may also involve interventions such as the building of formal chain financing institutions that allow for credit financing to enhance production capacity and facilitate payments. Credit provides a means for farmers to adjust to changes to improve their operations and to expand their operations to meet the increasing demand for agricultural products and new agricultural enterprises. Formal chain financing can take the form of warehouse receipt systems (WRS). According to FAO, (2016), WRS is a risk mitigation strategy aimed at protecting farmers from seasonal price risk variability by allowing them to store their product and receive a receipt indicating its existence and availability. However, WRS requires regular quality control and preservation that may be a challenge for fresh produce like tomatoes. Although warehouse receipts are more suited for grain commodities, insights from an expert are that warehouse receipts can work for short shelf-life commodities like tomatoes if the warehouse receipt system is used in combination with cold storage facilities. According to Chhatre et al., (2016), the lack of a well-developed cold chain infrastructure for the vegetable crops means that farmers cannot store their produce for long periods and have to sell their produce immediately after harvest. As a result, the prices of these commodities are subject to wide fluctuations. Figure 49 shows the number of experts who suggested a particular formal PRM strategy as being suitable for the tomato value chain.

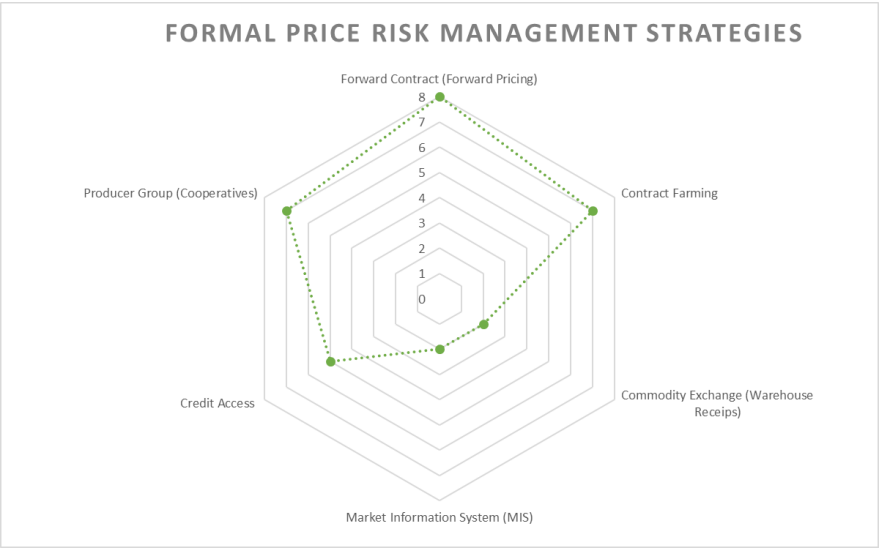

Figure 49: Formal PRM strategies suitable for the tomato value chain

5.6 The regulatory framework governing horticulture

According to experts, there is currently no specific regulatory framework governing the horticulture value chain in Zambia. This is the same in South Africa, where there is no specific governmental policy for the horticulture sector (EL&I, 2013). According to experts, regulations governing the activity of actors of brokers in the wholesale and retail market where fresh tomato produce is sold are absent. The absence of regulation governing broker behaviour in markets allows for an atmosphere of suspicion and lack of transparency of pricing of tomato produce in the form of tubende (hidden commissions). Markets in Zambia are currently under the control of city councils and are regulated by the Markets and Bus Stations Act. Regulations to enhance a farmer's ability to cope with price risk will require changes to the current Markets and Bus stations Act. According to Tschirley and Hichaambwa, (2010) the lack of any regulatory and enforcement structure in markets leads to questionable broker behaviour including charging of hidden commissions. Tubende contribute to the problem of price risk by creating price distortions that exacerbate the problem of price risk for tomato farmers. Tubende is a situation where a broker increases the price above what the farmer receives in addition to charging a commission for the broker's services. The farmer ends up paying double for the services rendered by the broker. Figure 50, shows the scoring of traders, retailers, and brokers based on trust and pricing transparency. As shown, brokers are the least trusted by farmers.

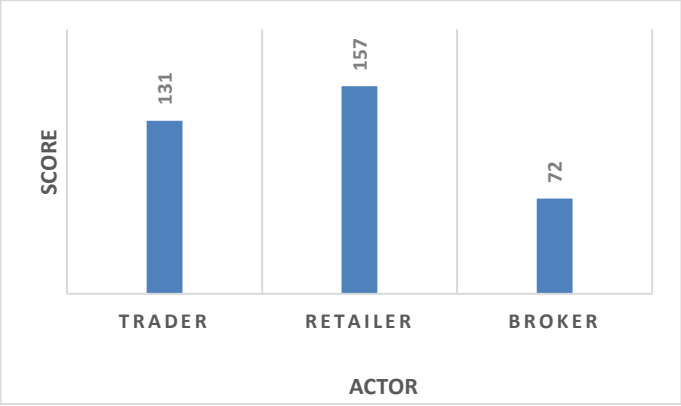

Figure 50: Scoring of actors based on trust and transparency of pricing

Experts also stated that regulation can also take the form of compensation for the unequal impacts of markets on farmers. According to Dietz (2010), compensation to farmers can take the form of crop insurance and taxation regimes that favour producers in the event of price variability. Experts also stated that small-scale farmers are notorious for breach of contract and as such, some processors and supermarkets avoid signing contracts preferring medium and large-scale farmers. According to Mwiinga (2009), small-scale farmers tend to break contracts. Forwards contracts as an instrument can enhance price variability for small-scale farmers if farmers can honour contracts. In addition to this, regulations governing conflict resolution in the chain in the form of court systems and third-party arbitration is required (KITT & IIRR, 2008). According to (RIS, 2019), Kenyan regulation on horticulture has a provision to reduce exploitation of growers who engage in contractual agreements with dealers by protecting producers from poaching of their produce. Regulation facilitating for cold storage infrastructure is also required. The construction of cold storage facilities in the chain to regulate inflow and outflow of produce at markets will help to avoid dramatic price swings. AGBIT, (2015), stated that cold storage chains are one of the key

interventions of enhancing the horticulture chain in Zambia. Experts suggested that councils enter into PPP's with the private sector to establish cold storage infrastructure in markets.

5.7 Governance of the tomato value chain

The tomato value chain in Mwalumina has a 'market type' of governance typical of the entire traditional sector of the tomato value chain Zambia. According to Dietz, (2010) market type of value chain governance is where there is no formal cooperation among actors in the chain, where there's is a high level of information asymmetry and where price rather than a chain leader is the governance mechanism; farmers sell their tomato produce in ad hoc spot markets. However, captive and modular governance systems guarantee reduced information asymmetry, formal cooperation among actors, business services support, information codification, and product and process standards. This agrees with Dietz, (2010) who states that in the modular governance system, linkages among actors in the chain are more substantial than in markets governance systems because of the high volume of information flowing among the actors. Figure 51, shows the current governance system of the tomato value chain in Mwalumina Area and the proposed governance systems in a reorganized tomato value chain.

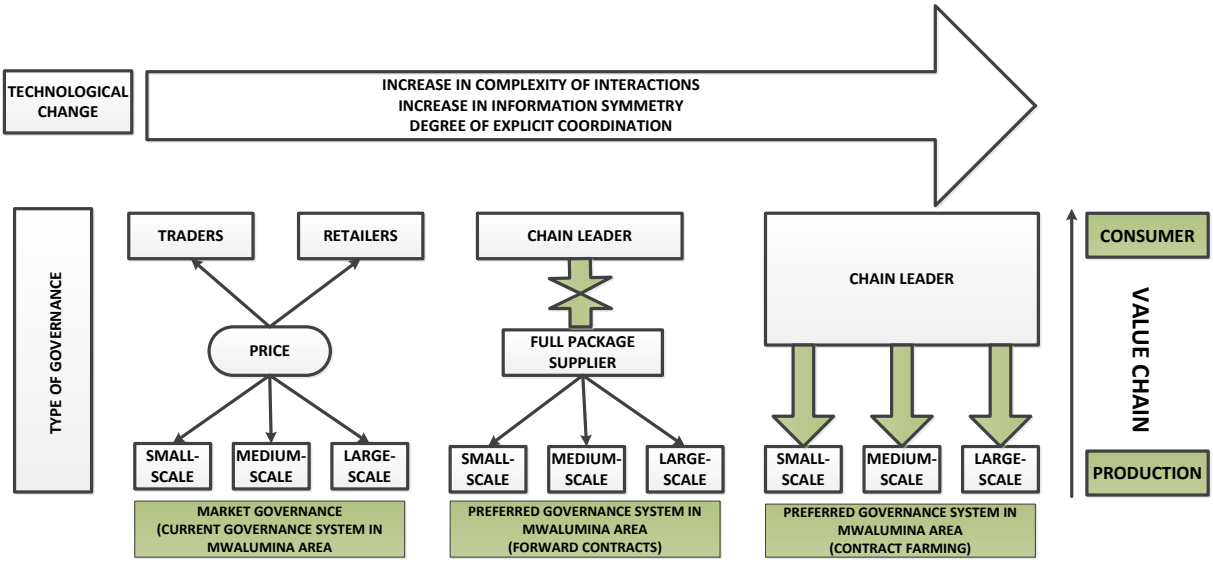

Figure 51: Proposed governance systems for the reorganization of the tomato value chain

Before farmers can participate under such a governance system, farmers require product, process, and functional upgrading. According to KIT, (2006), functional upgrading entails farmers taking up new activities in the chain such as grading, sorting, or cold storage. Process upgrading entails improving the production practices whereas product upgrading entails improved quality of produce. Figure 52 depicts a market interaction matrix showing the current position and preferred position for tomato farmers in Mwalumina Area. The figure also depicts the required interventions for horizontal and vertical integration.

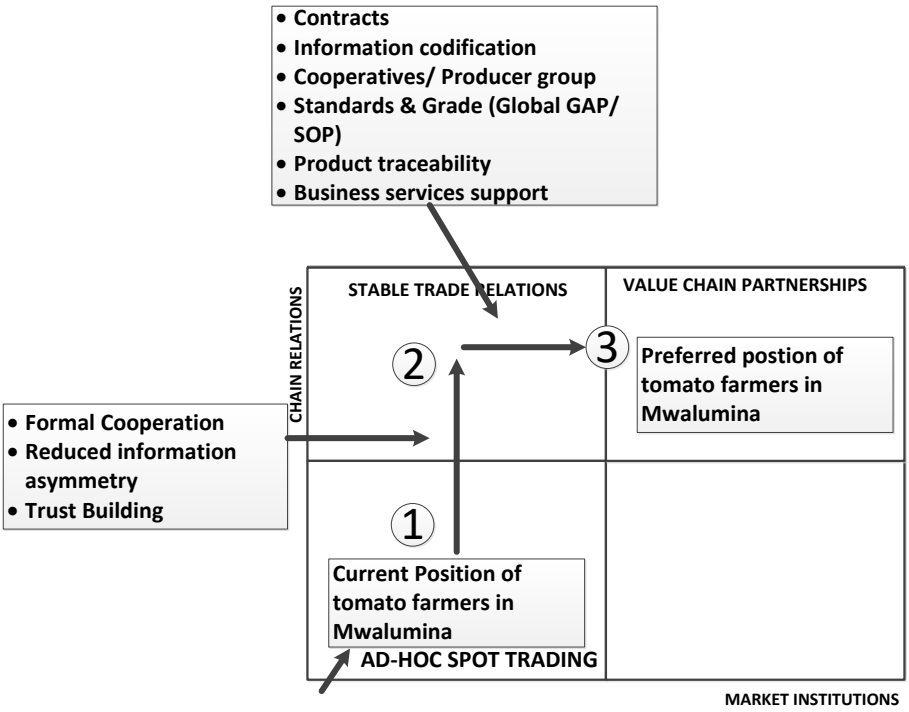

Figure 52: Market Interaction Matrix depicting preferred position tomato farmers in mwalumina Area

5.8 Inclusion factors into a reorganized tomato value chain

According to experts, before small-scale farmers can participate in a reorganized tomato value chain, farmers need education in tomato product and process upgrading. Process and product upgrading should take the form of HACCP, SOP, Global GAP certification, and other mandatory certification, BRIX requirements, and traceability. Most experts stated that farmers fail to meet the required quality and quantities to supply produce under contractual agreements. Louw and Jordan (2016) state that small-scale farmers face challenges in supplying produce under institutional agreements because of poor-quality produce and inconsistent supplies. Farmers also need to increase their bargaining and negotiation power through the formation of producer groups and cooperatives. Producer cooperatives can help farmers to meet the quality and quantity requirements for processors and supermarkets. Louw et al. (2007) stated that forming cooperatives can help farmers to organize production by scaling up to achieve economies of scale and competitiveness. Producer group and cooperatives formation can also help with financing activities in the tomato value chain by improving access to credit and pooled resources. According to experts, trust-building among actors in the chain is also required as there is a high incidence of contract breach among farmers in Zambia. Louw & Jordan stated that small scale horticulture farmers require value chain coordination mechanisms and human resource development to enable them to participate in an upgraded value chain.

Limitations of the research

The collection of data on non-crop and off-farm activities were limited to the types and number of activities and not the scale of the activities. Data on non-crop and off-farm income were collected as the total of the income from non-crop activities and off-farm activities respectively. Farmers were asked the types of livestock they rear but not the number of livestock they rear. Farmers were also asked about the types of off-farm activities they practice and not the income from specific activities. The analysis of results for non-crop and off-farm activities therefore could not compare farmers practicing different non-crop activities or off-farm activities based on the scale of the activity. The analysis therefore was done by grouping farmers based on the types of activities they practiced. The analysis of how one non-crop or off-farm activity compares with another could therefore not be done.

Influencing factors of the research

The researcher presumed that the majority of small-scale farmers do not have irrigation technologies however, the questionnaire survey revealed otherwise; all the respondent small-scale farmers had irrigation equipment albeit not as sophisticated as large and medium-scale farmers. The researcher also presumed that large-scale farmers employed formal PRM strategies but the questionnaire revealed that this was not the case. The researcher also presumed that they were differences in PRM strategies among the different classes of farmers however, data collected revealed that the PRM strategies being employed are largely the same across the different farmer sizes.

5.9 Reflection on Research Results

Design

I chose to focus my study on price risk management in the tomato value chain because documented literature and empirical studies show that price risk is one of the most important problems affecting the tomato value chain in Zambia. My research adopted a positivist approach with an explorative and descriptive research design. A dual approach was adopted because the objective of the research was to explore the PRM strategies among farmers and to gain insights on the measures that can be taken to reorganize the chain to alleviate the problem of price risk. This dual approach entailed that I collect both quantitative and qualitative data.

Planning & adjustments

The closure of airports as a result of the corona pandemic entailed that I was not able to travel back to my home country to collect data. I, therefore, had to engage the services of a proxy enumerator to collect data on my behalf. The design of my research therefore took into account the fact that the enumerator was inexperienced and not conversant about the topic. To reduce human error and to take into account time and resource constraints, I designed limited but specific and focused research questions. The nature of my research focus entailed that I employ a questionnaire survey, semi-structured interview, FGD, and literature review. Stakeholder analysis identified relevant stakeholders that could offer insights into the questions. Two stakeholders refused to participate in the research and replacements were made. Extension officers generated a camp list used to devise the sampling frame for the questionnaire survey.

Implementation & adjustments

The data collection started in mid-July and continued into the first week of August. Informed consent was sought from potential respondents and interviewees. However, there was apprehension by some farmers to meet with

the enumerator because of fear of infection and fear of abrogating government regulation on social distancing. Some participants of the FGD were apathetic about meeting in a group and refused to attend and replacements were made. To allay fears, the time for the FGD's was limited to 30 minutes however, in practice both FGD's took more than two hours to complete.

Methodology

The sampling of respondents involved purposive, stratified, and random sampling. The sampling of experts and key-informants involved purposive sampling. Experts and key-informants were purposively sampled because of the limited number of individuals and organizations with expertise on the research topic. Mwalumina Area was purposively sampled because of convenience as the area is close to the city and has a relatively accessible road network. However, the Mwalumina area has very few large-scale tomato farmers as such these had to be purposively sampled. Areas that are known to have a higher number of large-scale farmers were left out because of distance and poor accessibility. As such, the PRM strategies and the extent of the use of PRM strategies highlighted in these results may be different from what is happening in other areas where tomato farming is more pronounced.

A sample size less than a statically representative sample means that the reproducibility of the results may be low. It also means that extrapolation of the results to a large population cannot be done. However, I still believe that these results offer a glimpse into how the picture may look like in the wide context of Chongwe and Lusaka Province. Given the limitations and adjustments pointed out I believe these results and findings convey a fairly accurate picture of what is on the ground.

Almost all the findings and results from this research have been validated by literature from academic journals and reports from established national and multinational organizations. Going by the success stories of some of these strategies around the world, their adoption into the tomato value chain can ensure the sustainability of profits for farmers and other actors in the tomato value chain in Mwalumina Area. I am fairly confident that the results herein have a reasonable measure of validity and accuracy to render the research results and findings reliable.

CHAPTER SIX
6.0 CONCLUSION
6.1 Conclusion

The tomato value chain in Mwaumina has a market type of governance. Tomatoes farmers operate as chain actors with the absence of vertical and horizontal integration activities. In the last 12 months, all of the tomato produce was sold fresh in spot markets or exported to the neighbouring DRC. The tomato was sold to retailers via brokers who charged a commission for their services. Farmers faced price risk as a result of the price variability of tomato produce at spot markets. None of the farmers sampled were employing formal PRM strategies.

In the last 12 months, crop diversification and irrigation were the predominant PRM strategies among the farmers. Large scale farmers grew fewer crops but for more months than medium and small-scale farmers. Large-scale farmers irrigated their tomato for more months than medium and small-scale farmers and were, therefore, able to harvest tomato throughout the year. The Largescale farmers grew more varieties of tomato than medium and large-scale farmers.

There are no cold-storage facilities among all the farmers. Produce is taken to the markets as soon as they harvest to avoid losses. None of the respondents was a member of a tomato cooperative. The majority of farmers practiced fruit size grading. However, the farmers could not bargain for a higher price based on the quality of their produce at spot markets. None of the farmers practiced 'on-farm' processing of tomato. Value addition is a tool that can help farmers realize stable prices for their produce and reduce post-harvest losses. Only 50% of the farmers accessed extension support in the last 12 months. Extension support may help farmers access the information on PRM strategies. less than 50% of the farmers accessed credit. The major source of credit was from village saving. The major reason for those who did not access credit was the fear of default. Credit access may help farmers to cope with price risk thorough investments in income diversification. Non-crop Income diversification activities among the farmers included livestock rearing and off-farm activities.

The study found that the more months spent on irrigation the less the coefficient of variance of tomato price. Large and medium-scale farmers had a comparatively lower coefficient of variance of price for their tomato produce than small scale farmers. This is an indication that irrigation had a positive effect on the farmer's ability to cope with price risk. Farmers growing more varieties of tomato had a lower coefficient of variance of tomato price. Large scale farmers had a lower coefficient of variance of price of for their tomato compared to medium and small-scale farmers. Variety diversification had a positive effect on the farmer's ability to cope with price risk. Farmers practicing crop diversification by growing fewer crops were found to have a significantly higher income per hectare than farmers growing more crops. Non-crop and off-farm income as a proportion of tomato income was highest for small-scale farmers indicating that they benefited more from non-crop and off-farm income activities compared to medium and large-scale farmers. A comparison of total income among small-scale farmers who earned non-crop income and those that did not shows that small-scale farmers who earned non-crop had significantly more income than those farmers who did not earn non-crop income.

There was a significant association between farmer size and the number of crops. Small-scale farmers were more likely to grow more crops than the medium and large-scale farmers. Results show that there was a significant association between the number of months of irrigation and farm size. Larger farmers were more likely to irrigate for a longer period than medium and small-scale farmers. There was a significant association between farm size and variety diversification. Large scale farmers were more likely to grow more varieties than small-scale farmers. There was also a significant association between gender and access to credit. Female farmers were more likely to access credit than their male counterparts.

There is no cooperation and coordination among actors in the tomato value chain in the area. The chain is characterized by a high level of information asymmetry and low level of trust and transparency and price rather than a chain leader is the governance mechanism. Governance changes require the introduction of captive and modular governance value chain systems that guarantee reduced information asymmetry, formal cooperation among actors, provision of business services support, information codification, and product and process upgrading.

Farmers require both vertical and horizontal integration into the tomato value chain to cope with price risk more effectively. The horizontal movement of farmers in the chain can come through the building of formalized market institutions in the form of forward contracts with supermarkets and processors, commodity exchanges, and market information systems. Vertical integration can take the form of contract farming, formation of cooperatives, and warehouse receipts.

There is no specific governmental policy for the horticulture sector in Zambia. Markets are under the control of city councils and are regulated by the Markets and Bus Stations Act. Changes to the current Markets and Bus stations Act is required to tame broker behaviour in the form of hidden commissions and collusion. Hidden commission contributes to price risk by creating price distortions in markets. Regulations that will facilitate the construction of cold storage infrastructure at markets and compensate actors in the chain for unequal impacts of markets are also required. Regulations on court systems and third-party arbitration in case of disputes between actors in the chain are also required.

For small-scale tomato farmers to be able to participate sustainably in a reorganized value chain, they need education on product and process upgrading such as HACCP, SOP, Global GAP certification, and traceability. Farmers also need to increase their bargaining and negotiation power through the formation of producer groups and cooperatives.

CHAPTER SEVEN
7.0 RECOMMENDATIONS
7.1 Recommendations

This chapter presents recommendations for small-scale tomato farmers in Mwalumina Area to participate effectively in a reorganize tomato value chain. In light of the conclusion of this research the following farm level and chain level interventions are recommended:

Farmer level interventions

1. Improved knowledge and skills better production methods and entrepreneurial skills. This can be through improved access to extension services, farmers training schools, and farmer business schools.

2. Improved access to modern irrigation technologies. Increased access to funding through grants, credit, or subsides can help small-scale farmers access modern irrigation equipment.

3. Encourage chain activity integration through development programmes to train farmers in process and product upgrading. This includes training in on-farm value addition activities.

4. Development of collective institutions such as cooperatives and producer group associations among tomato farmers. By forming farming cooperatives farmers will reduce their transaction costs and increase their bargaining power. Cooperatives will also facilitate access to capital for processing equipment.

Chain level interventions

1. Facilitate the development of a chain vision by encouraging partnerships in the chain. Through improved coordination and communication among the actors in the chain, partnerships should be formed that reduce information asymmetry and allow for the provision of business support service.

2. Encourage intra-chain upgrading through the implementation of quality certification schemes required by supermarkets and processors such as Global GAP, MRLs, BRIX content, and water quality tests.

3. Facilitate for modular and captive governance systems in the chain that allow for forward contracts and contract farming and reduce market risk for farmers.

4. Changes to the Markets and Bus stations Act (2007) to prohibit uncompetitive behaviour and collusion among brokers to allow for trust and transparency in pricing and development of infrastructure at markets (cold storage infrastructure via PPP)

Table 7 shows the proposed business canvas for small-scale farmers in Mwalumina Area after implementation of the recommended farm level and chain level interventions. The proposed business canvas model shows that farmers have made horizontal and vertical movement in the chain to move from being chain actors to being chain activity integrators and chain partners.

Table 7: Proposed Business Canvas for tomato farmers in Mwalumina

<table>
<tr>
<td>Key partners
▪ MAO
▪ MCTI
▪ Processors
▪ Supermarkets
▪ ZABS
▪ ZWMA
▪ GLOBAL GAP
▪ City Council</td>
<td>Key Activities
▪ Tomato cultivation
▪ Fresh tomato supply
▪ Tomato processing
▪ Tomato packaging
▪ Distribution & marketing</td>
<td rowspan="2">Value proposition
▪ High-quality Tomato (Global GAP)
▪ Fresh tomato
▪ Tomato Paste
▪ Tomato Powder
▪ Tomato Juice
▪ Tomato Jam
(Product & process upgrading)</td>
<td>Customer Relationship
▪ Fair pricing
▪ Mutual trust
▪ Cooperation & coordination
▪ Traceability
▪ Business support services</td>
<td rowspan="2">Customer Segments
▪ Processors
▪ Supermarkets
▪ HORECA
▪ Spot market retailers</td>
</tr>
<tr>
<td>Partners Provide
▪ Extension & training
▪ Business environment
▪ Business support services
▪ Quality standards
▪ Weights & measures
▪ Certification
▪ Crop levies</td>
<td>Key Resources
Physical
▪ Tractor(s)
▪ Irrigation equipment
▪ Processing equipment
▪ Cold storage
▪ Transportation Truck(s)
Human
▪ Individual farmers
Financial
▪ Member share capital
▪ Business surplus
▪ Agricultural finance
▪ Value Chain finance</td>
<td>Marketing Channels
▪ Contracts
▪ MIS
▪ Warehouse receipts
▪ Commodity Exchange
▪ Brokers
(Change: the presence of regulatory framework governing the activity of brokers)</td>
</tr>
<tr>
<td colspan="3">Cost structure
▪ Packaging material
▪ Processing costs
▪ Transportation costs
▪ Salaries
▪ Wages</td>
<td colspan="2">Revenue streams
▪ Fresh Tomato sales
▪ Sale of processed tomato products
▪ Share capital</td>
</tr>
<tr>
<td colspan="5">Sustainability Issues
People: Empowerment of small-scale tomato farmers, increase employment in cooperatives and formal market institutions, improved livelihoods, increased youth involvement in agriculture.
Profits: Stable incomes, Higher incomes
Planet: Reduced post-harvest losses, Reduced greenhouse emissions</td>
</tr>
</table>

Figure 53 depicts a chain matrix showing the vertical and horizontal movement in the chain the small-scale farmers need to make improve their capability to cope with the price risk of tomato produce.

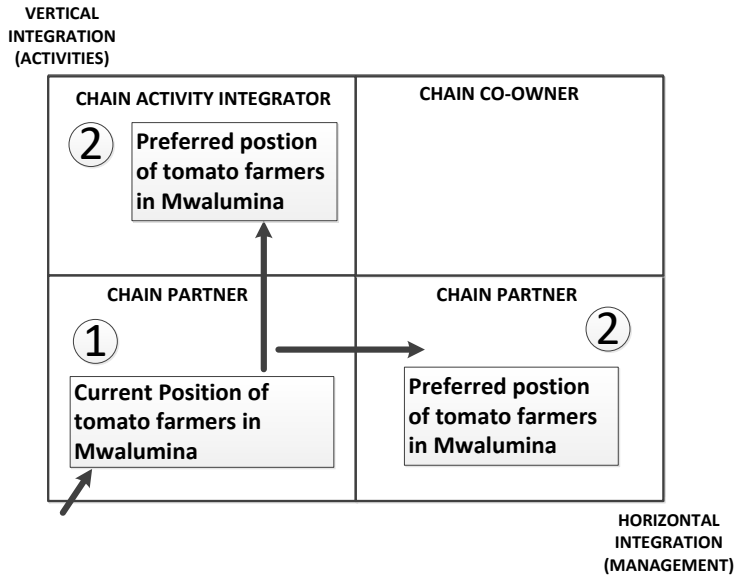

Figure 53: Vertical & Horizontal Integration of tomato farmers in Mwalumina Area

7.2 Theory of Change and Impact of Interventions

The theory of change is a specific type of methodology for planning, participation, and evaluation that is used by organizations to promote social change (Brest, 2010). The theory of change below specifies the long-term goals of the interventions to reorganize the tomato value chain to cope with price risk and the steps required to achieve the long-term goals. Tables 8 and 9 depict the theory of change and the impact of the recommendations.

Table 8:Theory of change and impact of interventions (Part 1)

INTERVENTION	INPUT	ACTIVITIES	OUTPUT	OUTCOME	IMPACT
Improve coordination and communication in the chain	Multi-stakeholder partnerships (Farmers, Brokers & Retailers)	• Formation of Farmer-retail-Broker association	• Farmer-retail-Broker association	• Improved price and market information sharing • Improved coordination	• ***Increased income from tomato sales for farmers.*** • ***Improve access to business support services***
Building of market institutions that enhance transactions within the chain.	• Stakeholder consultative meetings • Multi-stakeholder partnerships	• Signing of supply contracts	• Processing upgrading (HACCP, GLOBAL GAP) • Product upgrading (BRIX%, Coliform tests, E.Coli, MRLs)	• Supply of produce of the required quality & quantity to Supermarket, Processor, Wholesaler.	• ***Stable prices*** • ***Increased income from tomato sales.*** • ***Increased competitiveness***
Development programmes to improve knowledge and skills	• Training to farmers on production & marketing	• Extension service support • Farmer training schools • Farmer business schools	• Knowledge & skills in Global GAP, HACCP, MRLs, BRIX%, Colliforms, E.Coli • Marketing skills • Entrepreneurial skills	• Improved access to Market Information • Entrepreneurial skills • Global GAP certified tomato • HACCP • MRLs • Coliform & E.Coli • BRIX%	• ***Stable prices*** • ***Increased income from tomato sales*** • ***Increased competitiveness***
Improved access to modern irrigation technologies	Funding (Farmers own resources, grants, credit)	Procurement of modern irrigation equipment	Modern Irrigation equipment (Drip Irrigation)	• Increased area under irrigation • Increase in months of irrigated	• ***Stable prices*** • ***All-year-round production*** • ***Increased income from tomato sales***

Table 9: Theory of change (Part 2)

INTERVENTIONS	INPUTS	ACTIVITIES	OUTPUT	OUTCOME	IMPACT
Changes to the Markets and Bus stations Act (2007)	Multi-stakeholder partnerships (MCTI, MAO &MLG)	• Stakeholder consultative meetings • Regulatory impact statement	• Statutory instrument Act of parliament	• Regulated broker activity in markets • Abolishment of Tubende (Hidden commissions) Cold storage facilities	• ***Stable prices*** • ***Transparent pricing*** • ***Compensation for the unequal impact of markets*** • ***Reduced post-harvest losses***
Development of collective institutions (cooperatives/producer group)	Stakeholder consultative meetings	Formation of producer cooperative (Bye-laws & constitution)	• Producer cooperative Processing equipment	• Increased bargaining power • Improved quality & quantity of produce Value addition activities	• ***Stable Prices*** • ***Increased income from tomato sales*** • ***Product differentiation*** • ***Employment opportunities***
Development of formal chain financing mechanisms	• Multi-stakeholder partnerships Stakeholder consultative meetings	• Stakeholder consultative meetings	• Standardization • Supporting legal infrastructure Financing mechanisms	• Participation on the commodity exchange Participation in Warehouse Receipt System	• **Stable prices** • **Increased income from tomato**

Table 10 depicts the sustainability of the interventions to reorganize the tomato value chain in Mwalumina area in terms of the Triple Bottom Line (PPP). As shown in the table the interventions are crossing cutting in terms of people, the planet, and profits.

Table 10: Sustainability of interventions to reorganize the tomato value chain in Mwalumina Area

People	Planet	Profits
Increase participation in tomato production	Reduced post-harvest losses	Stable income from tomato sales
Increased involvement of the youth in tomato farming	Reduced greenhouse emissions	Increased income from tomato
Creation of employment through the formation of cooperatives	Increase the use of IPM	
Creation of employment through increased activity in formalized markets		
Improved livelihoods		

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APPENDICES

Appendix 1 Focus Group Discussion (Ranking & Scoring)

Group 1 Ranking & Scoring of Informal PRM

	RESPONDENT										SCORE	RANK
	1	2	3	4	5	6	7	8	9	10		
Activity												
Crop Diversification	4	4	6	5	4	6	4	3	1	6	43	2
Variety Diversification	3	3	2	2	3	2	1	2	4	2	24	5
Irrigation	2	2	1	3	2	1	2	1	3	1	18	6
Grading	6	1	4	4	1	3	6	4	2	3	34	4
Non-Crop Activities	5	5	3	6	6	4	5	6	5	5	50	1
Off-Farm Activities	1	6	5	1	5	5	3	5	6	4	41	3

Group 2 Ranking & Scoring of Informal PRM

	RESPONDENT										SCORE	RANK
	1	2	3	4	5	6	7	8	9	10		
Activity												
Crop Diversification	5	6	6	5	5	6	6	6	4	6	55	1
Variety Diversification	1	1	3	1	4	3	2	1	2	2	20	6
Irrigation	3	3	1	3	3	2	1	3	3	1	23	5
Grading	4	4	2	4	2	5	5	2	1	3	32	4
Non-Crop Activities	6	5	5	6	1	4	4	4	6	4	45	2
Off-Farm Activities	2	2	4	2	6	1	3	5	5	5	35	3

Group 1 Ranking & Scoring of formal PRM

	RESPONDENT										SCORE	RANK
	1	2	3	4	5	6	7	8	9	10		
Activity												
Contract Farming	5	5	4	5	4	5	4	5	4	5	46	1
Forward Contracts	4	1	2	2	5	4	5	4	3	4	34	2
Cooperatives	3	3	5	4	3	3	3	2	1	3	30	3
Commodity Exchange	2	4	1	1	1	2	1	1	5	1	19	5
Market Information Systems	1	2	3	3	2	1	2	3	2	2	21	4

Group 2 Ranking & Scoring of formal PRM

	RESPONDENT										SCORE	RANK
	1	2	3	4	5	6	7	8	9	10		
Activity												
Contract Farming	3	5	3	4	4	5	5	5	4	4	42	1
Forward Contracts	4	2	4	3	3	3	3	4	5	3	34	3
Cooperatives	5	3	5	5	5	4	4	3	3	1	38	2
Commodity Exchange	1	1	2	1	1	1	2	1	2	2	14	5
Market Information Systems	2	4	1	2	2	2	1	2	1	5	22	4

Appendix 2 Household Questionnaire Survey

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District of Lusaka Province of Zambia

Respondents: small, medium and large-scale farmers (n=40)

PART A: Introduction

Dear Respondent

You have been randomly selected to be part of a sample of tomato farmers in relation to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection. Your responses will be pooled together with those of other households and analyzed.

Part B: Respondent Identification

Farmer Code (Camp Initial and arbitrary number): …….

Date of Interview: …….

Gender of the farmer: …….

(Farm Location) Camp: ……

Part C: Background Information

Farmer Characteristics

No.	Description	Response
1	Age of farmer (years)?	
2	Highest level of education attained? None=0 Primary=1 Basic=2 Secondary=3 College=4 University=5	
3	Number of members of household including yourself?	
4	Number of years in tomato farming?	

Farm Characteristics

No.	Description	Response
1	How much of land did you cultivate in hectares in the last 12 months?	
2	How much land was cultivated to tomatoes in the last 12 months?	
3	How many months did you harvest tomato in the last 12 months?	
5	Distance to market? (Hours)	

Part D: Farmer Income Sources

Household Income by sources in the last 12 months (Gross Income)

No.	Source of Income	Amount (K)
1	Cash income from sale of tomato	
2	Cash income from sale of other crops	
3	Cash income from non-crop farming activities	
4	Cash income from off-farm investments	

What were the highest and lowest prices for price for tomato during the last 12 months?

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Month	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
Price/Crate																								
No of crates																								

Part E: Production and Post-Harvest Technologies

Production Practices

1. Please fill in the following Tables based on the last 12 months (Skip if Crop diversification is not practiced)

Crop Diversification	
Number of Crops other crops	**Number of months in the year you practice Crop diversification**

2. Please fill in the following Tables based on the last 12 months (Skip if Variety diversification is not practiced)

Variety Diversification	
Number of Varieties	**Number of months in the year you practice Variety diversification**

3. Please fill in the following Tables based on the last 12 months (Skip if irrigation is not practiced)

Irrigation	
What percentage of your tomato field was under irrigation in the last 12 months?	
How many months of the year did you irrigate your tomato?	

4. Please fill in the following Tables based on the last 12 months (Skip if Non-crop farming activities and off-farm investments are not practiced)

Activity	**How many times in months in the year do your practice non-crop farming activity?**
Non-crop farming activities (Self-Insurance Strategies)	
Specify: ……..	
Specify: ……..	
Specify: ……..	

Activity	**How many times in months in the year do your obtain income from off-farm investment?**
Off-farm Investments (Self-Insurance Strategies)	
Specify: ……..	
Specify: ……..	
Specify: ……..	

Post-Harvest Technologies

1. Do you have cold storage facilities?

Yes=1 No=2

(Answer the following question if previous answer was Yes or skip if No)

Percentage of total tomato produce placed in storage in last 12 months?	**Average number of days the tomatoes were placed in storage in the last 12 months**	**Maximum number of days the tomatoes can be placed in storage**

2. Do you do any value addition on your tomato?

Yes=1 No=2

(Answer the following question if previous answer was Yes or skip if No)

Tomato Value addition by proportion

Post- harvest Strategy	**Percentage of tomato produce**
Fresh tomato (untreated & ungraded)	
Coated tomato (Waxing)	
Graded tomato	
On farm Processed tomato	
TOTAL	**100%**

3. In what form did you process your tomato produce in the last 12 months? (Tomato sauce, paste, juice, powder, jam etc.)

PART F: Tomato marketing Channels

1. Percentage of produce by marketing channel and Ranking of pricing transparency by marketing channel?

Marketing Channel	**Percentage of tomato produce supplied in the last 12 months**	**What is your level of trust in relation to prices for your tomatoes produce? 1 to 6 (1 for most trusted and 6 for least trusted)**
Cooperative/Producer group		
Processor		
Trader		
Wholesaler		
Retailer		
Broker		
TOTAL	**100%**	

PART G: Formal PRM Strategies

1. What percentage of your tomato produce was supplied using the following strategies in the last 12 months? (indicate zero if strategy does not apply)

Strategy	**Percentage of produce**
Contract farming	
Forward Contract	
Forward pricing or Cooperative/Producer Group	
Warehouse Receipts	
Commodity Exchange	
Other (specify)……	
Sold to Fresh to open market	
Total	**100%**

PART G: BUSINESS SUPPORT SERVICES

A) Access to credit services

1. Indicate the appropriate box(s) for institutions that have availed you credit for tomato production in the last 12 months? (if not answer question 2)

Source	**Purpose (e.g. Inputs,**	**Interest rate**	**Collateral**	**Amount Borrowed (Cash/Kind)**	**Loan Tenure**

2. If you did obtain loan specify why?
No need= 1
Lack of collateral= 2
Lack of information on source of credit= 3
Other (specify): …….

B) access to extension services

Activity	**Number of times extension service was accessed in the last 12 months**
Government [ ]	
Processor [ ]	
Supermarket [ ]	
Other (Specify) [ ]…….	
I don't have access to Extension services [ ]	

Appendix 3 Semi-Structured Interview (Experts-Private Sector)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District of Lusaka Province Of Zambia

Key Informant Organizations: Zambia National Farmers Union (ZNFU), National Union for Small Scale Farmers in Zambia (NUSFAZ), Zambian Commodities Exchange Limited (ZAMACE), Indaba Agricultural Policy Research Institute (IAPRI) (n=4)

Aim of the interview:
This semi-structured interview aims to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Informant
You have been purposively selected to be part of a sample of experts in relation to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection and any reports or publications resulting from this research will keep your responses anonymous. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification

_____
Date of Interview: ……..
Name of Enumerator: ……...
Name of respondent: ……
Organization respondent is represented: ……
_____

PART B: INTERVIEW QUESTIONS
1. What is your role in your organization?
2. What is the difference in risk attitudes among the difference classes of farmers?
3. What effect does broker activity in fresh vegetable wholesale markets like Soweto have an on the wholesale prices of tomato?
4. What is the extent of coordination and cooperation among the different actors in the tomato value chain in Lusaka and how does this affect farmers ability to cope with price risk?
5. In what ways does the current state of infrastructure and cold storage facilities at wholesales markets influence tomato prices?
6. What informal price risk management strategies are employed by small-scale tomato farmers?
7. What changes are required to be made to the current institutional and regulatory framework governing the tomato value chain to reduce the variability of price for tomatoes and wholesale and retail markets?
8. What changes are required to the governance of then chain in order to reduce price risk for tomato farmers.
9. What formalized price risk strategies can small scale tomato adopt?
10. What socio-economic considerations should be taken into account before small-scale tomato farmers can take up formalized price risk management strategies?

Appendix 4 Semi-Structured Interview (Experts-Government-DACO & DMDO)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District Of Lusaka Province Of Zambia

Key Informant Organization: Department of Agribusiness and Marketing (n=2)

Aim of the interview:
The aim of this semi-structured interview is to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Respondent
You have been purposively selected to be part of a sample of experts in relations to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification

_____
Date of Interview: ……..
Name of Enumerator: ……..
Name of respondent: ……
Organization respondent is represented: ……
_____

PART B: INTERVIEW QUESTIONS
1. What is your role in your organization?
2. What is the difference in price risk attitudes among the difference classes of farmers?
3. What price risk management strategies are employed by tomato farmers?
4. What is the prevalence and effectiveness of formal PRM strategies used by tomato farmers in the study area?
5. What formalized Price Risk Management strategies are employed by tomato farmers in the study area?
6. What Formalized Price Risk Management strategies can small scale tomato farmers?
7. What is the extent of tomato farmer cooperatives and producer group in the study area?
8. What are the sources of credit among small-scale tomato farmers?
9. What is the extent of coordination and cooperation among actors in the tomato value chain?
10. What influence does broker activity have on small-scale tomatoes farmers ability to cope with price risk?
11. What is the extent of infrastructure and cold storage facilities for fresh vegetable at wholesale markets in Lusaka?
12. What changes are required to be made to the current regulatory framework of the tomato value chain to reduce the price risk faced by tomato farmers?
13. What changes are required to the governance of then chain in order to reduce the price risk for tomato farmers?
14. What socio-economic considerations should be taken into account before small-scale tomato farmers can take up formalized price risk management strategies?

Appendix 5 Semi-Structured Interview (Expert-Government Extension Officers-MAO)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District Of Lusaka Province of Zambia

Key Informant Organization: Ministry of Agriculture (n=2)

Aim of the interview
The aim of this semi-structured interview is to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Respondent
You have been purposively selected to be part of a sample of experts in relations to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification

_____
Date of Interview: ……..
Name of Enumerator: ……..
Name of respondent: ……
Organization respondent is represented: ……
_____

PART B: INTERVIEW QUESTIONS

1. What is your role in your organization?
2. What is the difference in price risk attitudes among the difference classes of farmers?
3. What price risk management strategies are employed by tomato farmers?
4. What is the prevalence and effectiveness of formal PRM strategies used by tomato farmers in the study area?
5. What formalized Price Risk Management strategies are employed by tomato farmers in the study area?
6. What Formalized Price Risk Management strategies can small scale tomato farmers?
7. What is the extent of tomato farmer cooperatives and producer group in the study area?
8. What are the sources of credit among small-scale tomato farmers?
9. What is the extent of coordination and cooperation among actors in the tomato value chain?
10. What influence does broker activity have on small-scale tomatoes farmers ability to cope with price risk?
11. What is the extent of infrastructure and cold storage facilities for fresh vegetable at wholesale markets in Lusaka?
12. What changes are required to be made to the current regulatory framework of the tomato value chain to reduce the price risk faced by tomato farmers?
13. What changes are required to the governance of then chain in order to reduce the price risk for tomato farmers?
14. What socio-economic considerations should be taken into account before small-scale tomato farmers can take up formalized price risk management strategies?
15. What is the extent of extension services provision to tomato farmers?

Appendix 6 Semi-Structured Interview (Key Informant-Trader)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District of Lusaka Province of Zambia

Key Informant Organization: Tomato Trader (n=2)

Aim of the interview
The aim of this semi-structured interview is to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Respondent
You have been purposively selected to be part of a sample of experts in relations to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection and any reports or publications resulting from this research will keep your responses totally anonymous. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification

_____
Date of Interview: ……..
Name of Enumerator: ……..
Name of respondent: ……
Organization respondent is represented: ……
_____

PART B: INTERVIEW QUESTIONS
1. Where do you supply your tomato? (wholesale market, retail market or direct to consumers)
2. What is the extent of access to market information sharing between traders and by small-scale tomato farmers?
3. What is the extent of access to coordination between traders and by small-scale tomato farmers? (loan or extension support e.t.c.)
4. What payment methods do you use when buying tomatoes from farmers? (market price or fixed price/contracts)
5. Do you source tomato from individual farmers (small, medium, large scale or from cooperatives (producer groups)?
6. What is the extent of cooperation between you and farmers in the Chain?

Appendix 7 Semi-Structured Interview (Key Informant-Wholesaler)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District of Lusaka Province of Zambia

Key Informant Organization: Tomato Wholesaler (n=1)

PART A: INTRODUCTION

Aim of the interview:
The aim of this semi-structured interview is to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Respondent
You have been purposively selected to be part of a sample of experts in relations to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection and any reports or publications resulting from this research will keep your responses totally anonymous. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification

_____
Date of Interview: ……..
Name of Enumerator: ……..
Name of respondent: ……
Organization respondent is represented: ……

_____

PART B: INTERVIEW QUESTIONS

1. Where do you supply your tomato? (wholesale market, retail market or direct to consumers)
2. What is the extent of access to market information sharing between traders and by small-scale tomato farmers?
3. What is the extent of access to coordination between traders and by small-scale tomato farmers? (loan or extension support e.t.c.)
4. What payment methods do you use when buying tomatoes from farmers? (market price or fixed price/contracts)
5. Do you source tomato from individual farmers (small, medium, large scale or from cooperatives (producer groups)?
6. What is the extent of cooperation between you and farmers in the Chain?
7. What are your quality requirements for the tomatoes you purchase?
8. What is the relationship between the ability to meet quality requirement and the characteristic of farmers (small, medium or large-scale farmers)?

Appendix 7 Semi-Structured Interview (Key Informant-Processor)

Price Risk Management Among Small-Scale Tomato Farmers: A Case of Mwalumina Area in Chongwe District of Lusaka Province of Zambia

Key Informant Organization: Processor (n=1)

Aim of the interview:
The aim of this semi-structured interview is to explore the formalized strategies small-scale tomato can use to cope with tomato price variability.

Dear Respondent
You have been purposively selected to be part of a sample of experts in relations to the topic stated above. You are kindly requested to answer the following questionnaire as truthfully as possible. Be assured of confidentially and anonymity in the process of data collection and any reports or publications resulting from this research will keep your responses totally anonymous. Your responses will be pooled together with those of other experts and analyzed. Thank you for your participation!

PART A: Semi-Structured Interview Respondent Identification
Date of Interview: ……..
Name of Enumerator: ……
Name of respondent: ……
Organization respondent is represented: ……

PART B: INTERVIEW QUESTIONS
1. What is your role in the tomato value chain in Lusaka Province?
2. Where do your source tomatoes for processing? (Cooperatives/contracted farmers/individual farmers/small-scale, Medium-scale, large-scale)?
3. What proportion of your tomato is sourced from small-scale farmers?
4. Do you source the crops directly from farmers or via traders? (middlemen)
5. What payment mechanism do your use when paying farmers for their produce? (Forward contract, current market price)
6. What are your quality requirements for the tomatoes you purchase?
7. What is the relationship between the ability to meet quality requirement and the characteristic of farmers (small, medium or large-scale farmers)?
8. What is the extent of breach of contract among your small, medium and large-scale tomato farmers?
9. What characteristics should small-scale farmers adopt to be able to supply you tomatoes?

Appendix 8 Focus Group Discussion

Price risk management among small-scale tomato farmers: A case of Mwalumina Area in Chongwe District of Lusaka Province of Zambia

Respondents= small-scale farmers (n=20) (n=10 females; 10 males)

PART A: INTRODUCTION

Dear Respondent

You have been randomly selected to be part of a sample of tomato farmers in relations to the topic stated above. You are kindly requested to participate in a focus group discussion on the topic stated above. You are requested to be as truthfully as possible during the discussion. Be assured of confidentially and anonymity in the process of data collection. Be assured that the information you provide will be treated confidentially.

Preference Ranking & Scoring

a) Informal price risk management strategies currently being employed by small-scale. How do they rank these strategies in terms of effectiveness against price risk in relation to analysis of findings? The aim was to communicate these strategies to all the farmers present and facilitate for a learning process on the most effective coping strategies for price variability in the view of farmers. (preference ranking was used to determine the most effective informal price risk management strategies in the perception of farmers)

b) Formal price risk management strategies highlighted by experts are explained to the small-scale tomato farmers. The issue is to communicate these strategies to all the farmers present and facilitate for a learning process on their most preferred formal price risk management strategies (preference ranking will be used to rank the most preferred formal price risk management strategies. (preference ranking was used to determine formal price risk management strategies that farmers perceive as being suitable for them)

	RESPONDENT										SCORE	RANK
	1	2	3	4	5	6	7	8	9	10		
Activity												

Appendix 9 Statistics

A. LEAST SIGNIFICANT DIFFERENCE OF COV OF PRICE RELATIVE TO IRRIGATION

Multiple Comparisons						
Dependent Variable: COV						
LSD						
(I) AGGIRRI	**(J) AGGIRRI**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Zero to Two Months	Three to Five Month	.15146	.07885	.060	-.0064	.3094
	Six to Eight Month	.27351*	.12045	.027	.0323	.5147
Three to Five Month	Zero to Two Months	-.15146	.07885	.060	-.3094	.0064
	Six to Eight Month	.12205	.12876	.347	-.1358	.3799
Six to Eight Month	Zero to Two Months	-.27351*	.12045	.027	-.5147	-.0323
	Three to Five Month	-.12205	.12876	.347	-.3799	.1358
*. The mean difference is significant at the 0.05 level.						

B. VARIETY DIVERSIFICATION EFFECTIVENESS

ANOVA					
COV					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.261	1	.261	3.341	.073
Within Groups	4.535	58	.078		
Total	4.797	59			

C. ON FARM GRADING

INDEPENDENT SAMPLES TEST										
		Levene's Test for Equality of Variances		**T-TEST FOR EQUALITY OF MEANS**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
COV	Equal Var. Ass	.617	.435	-1.011	58	.316	-.09983	.09875	-.29750	.09785
	Equal Var. Not Ass.			-.988	12.603	.342	-.09983	.10100	-.31873	.11908

E. OFF-FARM INCOME RELATIVE TO FARM SIZE CLASS

ANOVA					
PROPORTIONOFFINCOME					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	70878.550	2	35439.275	2.746	.073
Within Groups	735544.033	57	12904.281		
Total	806422.583	59			

F. COEFFICIENT OF VARIATION OF PRICE

ANOVA					
COEFFICIENT OF VARIATION OF PRICE RELATIVE TO IRRIGATION MONTHS					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.544	2	.272	3.645	.032
Within Groups	4.253	57	.075		
Total	4.797	59			

ANOVA					
COEFFICIENT OF VARIATION OF PRICE RELATIVE TO AREA OF IRRIGATED LAND					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.497	7	.071	.858	.545
Within Groups	4.300	52	.083		
Total	4.797	59			

ANOVA					
COEFFICIENT OF VARIATION OF PRICE RELATIVE TO VARIETY DIVERSIFICATION					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	.261	1	.261	3.341	.073
Within Groups	4.535	58	.078		
Total	4.797	59			

G. COMPARISON OF TOTAL INCOME BETWEEN FARMERS EARNING OFF FARM INCOME AND NOT EARNING OFF-FARM INCOME

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	5.498	.022	1.064	58	.292	12181.458	11443.889	-10725.975	35088.892
	Equal variances not assumed			1.796	52.524	.078	12181.458	6784.244	-1428.889	25791.806

H. LEAST SIGNIFICANT DIFFERENCE OF NUMBER OF CROPS RELATIVE TO INCOME PER HECTARE

Multiple Comparisons						
Dependent Variable: INCOME ACCURATE						
	4	-14802.667	25637.932	.978	-87110.03	57504.70
1	2	39075.317*	14461.744	.009	10093.33	68057.30
	3	42715.736*	14753.930	.005	13148.20	72283.27
	4	45379.783*	19708.035	.025	5884.00	84875.57
	6	60182.450*	21169.825	.006	17757.17	102607.73
2	1	-39075.317*	14461.744	.009	-68057.30	-10093.33
	3	3640.419	15733.909	.818	-27891.04	35171.88
	4	6304.467	20451.994	.759	-34682.25	47291.18
	6	21107.133	21864.102	.339	-22709.51	64923.77
3	1	-42715.736*	14753.930	.005	-72283.27	-13148.20
	2	-3640.419	15733.909	.818	-35171.88	27891.04
	4	2664.048	20659.634	.898	-38738.78	44066.88
	6	17466.714	22058.453	.432	-26739.41	61672.84
4	1	-45379.783*	19708.035	.025	-84875.57	-5884.00
	2	-6304.467	20451.994	.759	-47291.18	34682.25
	3	-2664.048	20659.634	.898	-44066.88	38738.78
	6	14802.667	25637.932	.566	-36576.90	66182.23
6	1	-60182.450*	21169.825	.006	-102607.73	-17757.17
	2	-21107.133	21864.102	.339	-64923.77	22709.51
	3	-17466.714	22058.453	.432	-61672.84	26739.41
	4	-14802.667	25637.932	.566	-66182.23	36576.90
*. The mean difference is significant at the 0.05 level.						

I. COMPARISON OF TOTAL INCOME BETWEEN FARMERS EARNING AND NOT EARNING NON-CROP INCOME

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TOTAL INCOME	Equal variances assumed	98.215	.000	-2.866	58	.006	-28028.199	9779.245	-47603.485	-8452.913
	Equal variances not assumed			-1.748	13.707	.103	-28028.199	16036.146	-62491.472	6435.075

J. COMPARISON OF TOTAL INCOME BETWEEN FARMERS EARNING AND NOT EARNING OFF FARM-INCOME

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TOTALOFF	Equal variances assumed	.013	.908	-10.538	58	.000	-103223.455	9795.791	-122831.862	-83615.048
	Equal variances not assumed			-11.393	4.918	.000	-103223.455	9060.379	-126631.037	-79815.872

K. CROP DIVERSIFICATION BY FARMER SIZE

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.315[a]	4	.010
Likelihood Ratio	12.697	4	.013
Linear-by-Linear Association	5.812	1	.016
N of Valid Cases	60		

L. VARIETY DIVERSIFICATION BY FARMER SIZE

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	30.496[a]	4	.000
Likelihood Ratio	22.353	4	.000
Linear-by-Linear Association	14.555	1	.000
N of Valid Cases	60		

M. IRRIGATION BY FARMER SIZE

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	50.556[a]	4	.000
Likelihood Ratio	29.587	4	.000
Linear-by-Linear Association	29.253	1	.000
N of Valid Cases	60		

N. SMALL SCALE FARMERS NON-CROP INCOME

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TOTAL INCOME	Equal variances assumed	3.439	.071	1.633	38	.111	8086.882	4953.115	-1940.176	18113.939
	Equal variances not assumed			2.879	36.331	.007	8086.882	2808.592	2392.594	13781.169

Appendix 10: Consent Form

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Date: **September 9th 2020**

Name of Student: **Anthony Mulenga Shula**

E-mail address: **anthony.shula@yahoo.com**

Theme/Study: **Agricultural Production Chain Management-APCM (Horticulture)**