Global Scientific JOURNALS
GSJ: Volume 10, Issue 4, April 2022, Online: ISSN 2320-9186
www.globalscientificjournal.com

Price Risk Management among small scale tomato farmers- A case of Mwalumina Area in Chongwe District of Zambia

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Abstract

Context: The majority of small-scale tomato farmers in Zambia sell their produce in spot markets located in urban centers. Price variability of tomato produce characterizes the trading of tomatoes. Price variability of tomato produce at markets is a result of lack of long-term cold storage infrastructure in urban markets, lack of coordination among actors in the value chain, lack of a regulatory framework to govern activity in markets and bio-physical factors such as pests and disease damage, erratic rainfall and limited access to irrgation technologies.

Purpose: Small scale farmers in the study area face price risk when selling their tomatoes at markets. Historically, the prices for tomato produce in Zambia at wholesale and retail levels have been highly variable to the detriment of farmers especially small-scale farmers. So the objective of this study was to explore the price risk management strategies (PRMS) 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.

Research Method: The study made use of both quantitative and qualitative approaches employing descriptive and exploratory research designs. Data collection instruments included survey questionnaires, semi-structured interviews, focus group discussions, and literature review. Stratified random sampling was used to sample sixty respondent tomato farmers from Mwalumina Area. Purposive sampling was used to sample twelve experts to provide insights on the tomato value chain. Data analysis involved the use coefficient of variance (COV), Chi-test and thematic coding and transcription.

Research Limitation: The use of a small sample size means that the results can not be generalized to a larger population. The collection of data on income diversification activities was limited to the types and

number of activities and not the scale of the activities; the comparison of income diversification based on the scale of the activity could not be done therefore

Originality/Value: Price risk affects the livelihood of the most vulnerable particularly resource-poor small-scale tomato farmers by reducing their ability to participate effectively in markets. The insights generated from this study can help to bridge the knowledge gap that exists on the use of formal and non-formal price risk management strategies (PRM) among small-scale tomato farmers.

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

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). 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 1 depicts the price volatility of tomato in the 2017/2018 farming season.

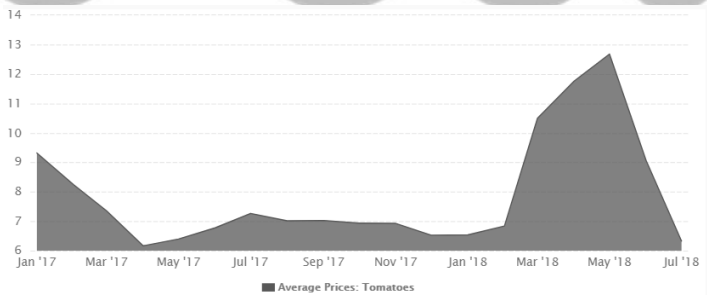

Figure 1: Price volatility of tomato 2017/2018 season, Source: Adapted from Chapoto et al. (2018)

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.

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 value chain serving Lusaka City is depicted in figure 1. 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). 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).

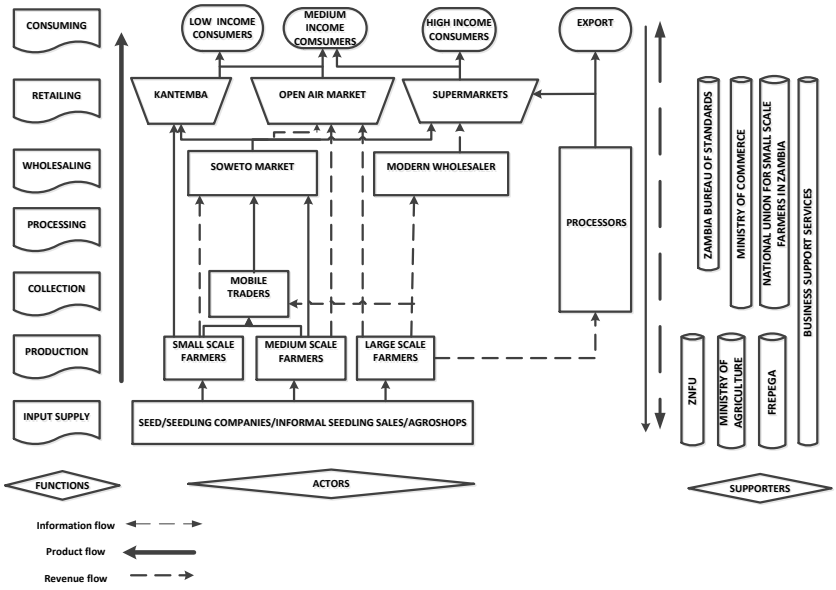

Figure 2: Tomato value chain of Lusaka City Source: Adapted from Tschirley & Hichaambwa, (2010)

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, market information systems, 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). According to (Aimin, 2010) It is abundantly clear that considerations of risk cannot be avoided when addressing agricultural issues. In Aimin's, (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. Zambian farmers in general and farmers in the study area have not been an exception, as employ informal PRM strategies 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 PRM strategies. Hence, the need to explore on the PRM strategies currently 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.

MATERIALS AND METHODS

Sampling Procedure and Data Description

The District of Chongwe lies in Lusaka Province in a region associated with poor rainfall of between 800 and 1000 mm per year. Tomato is the predominant crop grown with farmers following a crop rotation with maize and other vegetables (Jenkins, et al., 2015). The Ministry of Agriculture has divided Chongwe District into 5 zones with each zone divided into 28 agricultural camps. 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. A sample of 5 large-scale farmers (n=5) was obtained by purposive sampling. A 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). A sample of 20 respondents was obtained from the 60 respondents originally sampled for the quantitative survey to paticpate in focus group discussions. 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.

Analytical Tecniques

Quantitative data analysis involed the use of means, frequencies, percentages, coefficient of variance (COV), analysis of variance (ANOVA), independent t-test, Chi-test and preference ranking. Qualitative data was analyzed by thematic coding and transcription. 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.

RESULTS & DISCUSSION

Overview of the situation 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. According to Taylor et al. (2009), 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. Figure 2, 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 other than the cultivation of tomato and marketing of tomato in spot markets. There is also limited coordination and cooperation between farmers and other actors in the chain. In addition, farmers lack market information and have no bargaining power to negotiate for higher and stable prices.

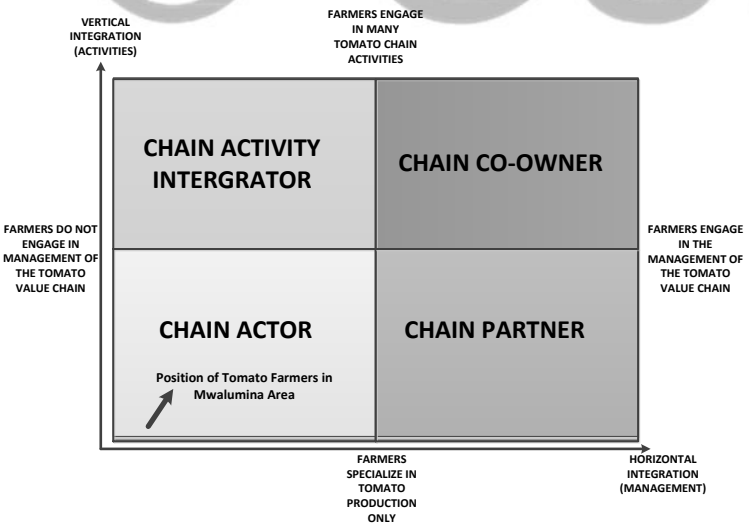

Figure 3: Chain Matrix of Tomato farmers for Mwalumina

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

Crop diversification and irrigation were the predominant PRM strategies employed by the farmers. 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.. 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. (2012), 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. Results further show that large scale farmers grew more tomato varieties and practiced variety diversification for more months 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. 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. The study also found that none of the farmers had access to cold-storage facilities. 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 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. It was also found that none of the farmers was a member of a tomato cooperative. Experts stated that there are no tomato producer groups or cooperatives in the area. By not be organized in cooperatives or groups, farmers cannot 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. 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. Tripathi et al. (2017) stated that on-farm processing can be helpful as a tool against market price fluctuation and post-harvest losses. Only 50% of the farmers sampled accessed extension support. Extension services support can enhance access to information on more efficient production methods and technologies to enhance productivity and cope better with price risk. Less than 50% of the farmers accessed credit. 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 adaptation measures and abandoning relatively risky monocropping systems. 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 previous 12 months. All the medium and small-scale farmers practiced off-farm income-earning activities in the previous 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. According to Teshome & Edriss (2013), households with larger farm sizes require more time to cultivate, and as such large farmers tend to involve more in farming activities than diversification activities. Figure 4 depicts the off farm activities practices by farmers in the study area.

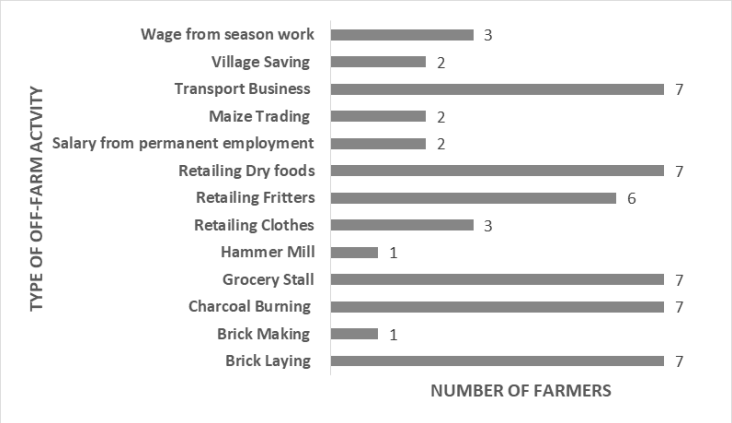

Figure 4: Off farm activities practices by farmers

Effectiveness of Informal PRM Strategies

According to figure 5 the more 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. The reason for this is that the more 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. 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. In the FGD as depicted in Figure 7 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.

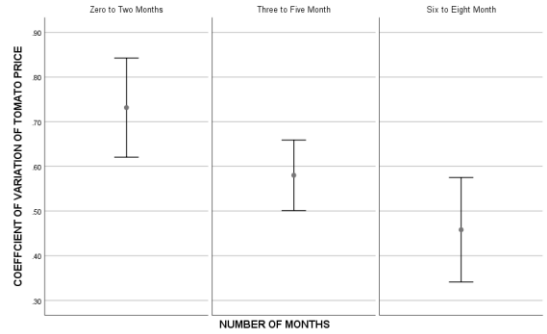

Figure 5: Coefficient of variation of price relative to months of irrigation

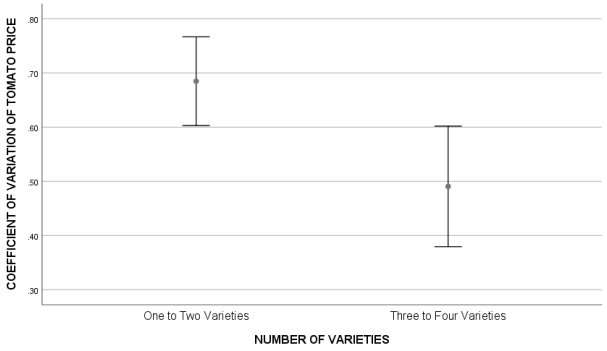

Figure 6: Coefficient of variation of price relative to number of tomato varieties grown

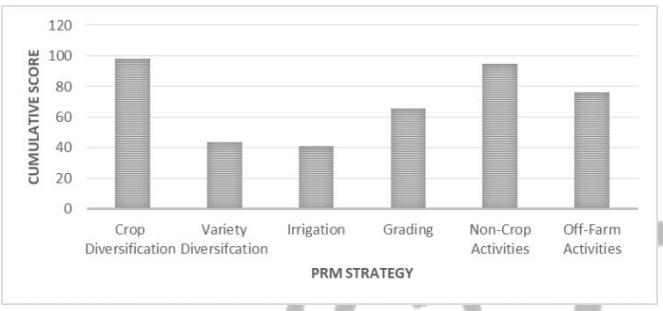

Figure 7: FGD scoring of NF-PRM strategies

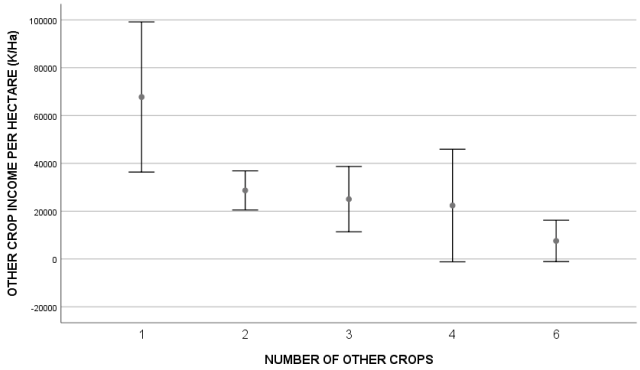

Figure 8: Income per hectare relative to number of crops

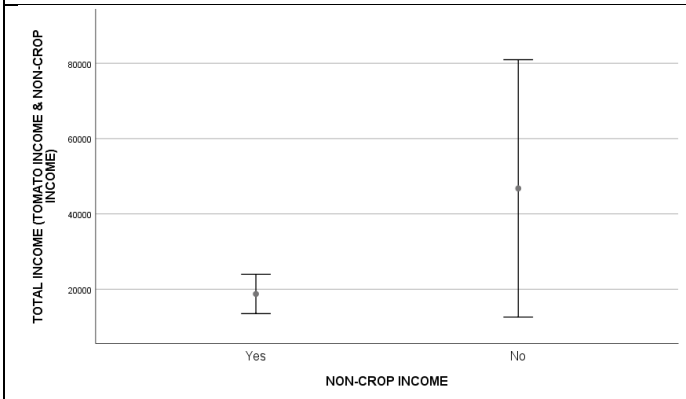

Figure 9: Comparison of total income of farmers who earned and did not earn non-crop income

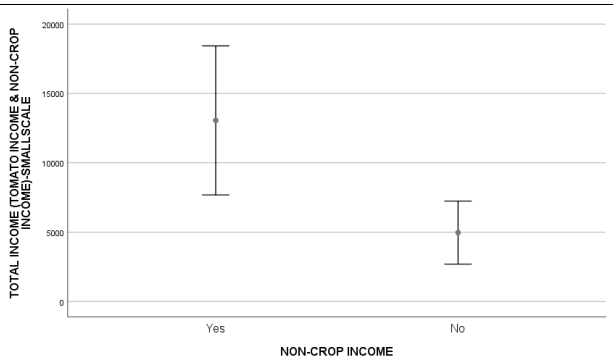

Figure 10: Comparison of total income Small-scale farmers earned and did not earn non-crop income

As depicted in Figure 6, 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. 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 et al. (2007) found that variety diversification strongly increases expected revenues and can reduce the cost of risk. 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, had a higher income per hectare from crop diversification than small-scale farmers; this is depicted in Figure 8. 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 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 as depicted in Figure 9. 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 & 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. As depicted in Figure 10, 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 income had significantly more total income than those who did not earn non-crop 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.

Determinants of PRM strategies among tomato farmers

The socio-economic factors tested include age, gender, education, household size, farm size, farming experience, credit access, and extensions access. 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 as depicted in Figure 11. Small scale farmers are more likely to grow more crops than other farmers. According to Gupta & 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. Results also 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 as depicted in Figure 12. 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 as depicted in Figure 13. 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. As depicted in Figure 14, there was also a significant association between gender and access to credit. 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 & 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.

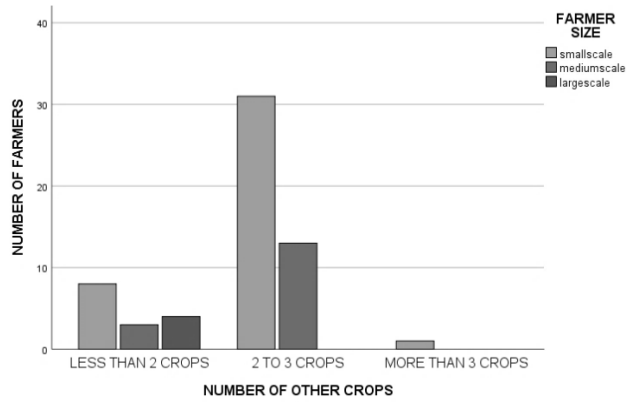

Figure 11: Difference in crop diversification based on farmer size

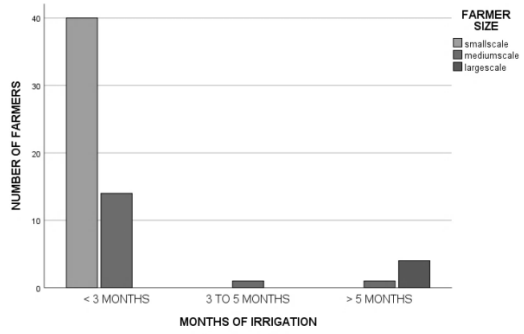

Figure 12: Difference in months of irrigation based on farmer size

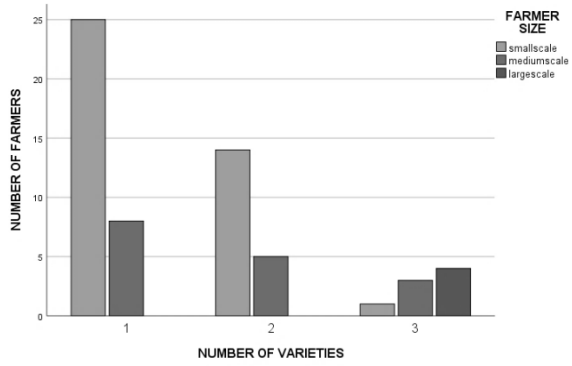

Figure 13: Difference in number of tomato varieties per farmer size

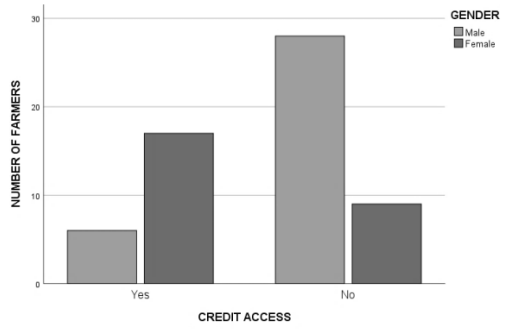

Figure 14: Difference in credit access based on gender

Formal PRM strategies for small-scale tomato farmers

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. 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. Figure 15 depicts the market interaction matrix for tomato in Mwalumina Area and shows the horizontal and vertical movement required for them to alleviate price risk.

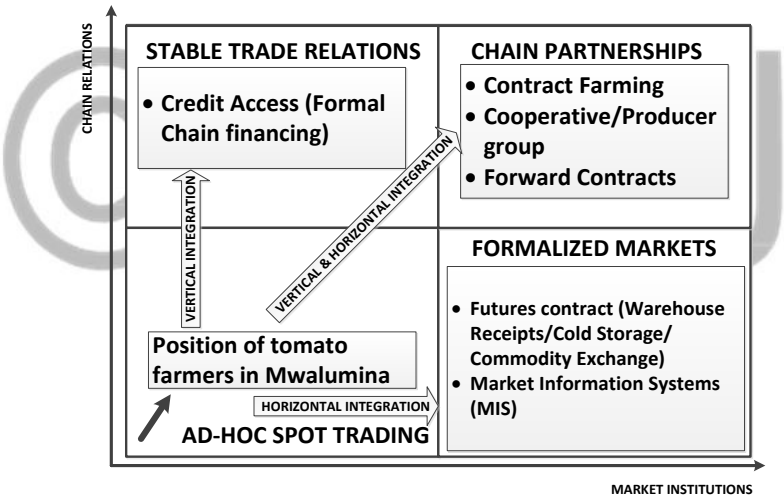

Figure 15: Market Interaction Matrix for Mwalumina Area

Vertical integration of farmers in Mwalumina can take the form of contract farming. According to Kharallah & Kirsten (2001); Stefanson & 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) 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. 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. 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.

The regulatory framework governing the horticulture sector

According to experts, there is currently no specific regulatory framework governing the horticulture value chain in Zambia. However, markets in Zambia are currently under the control of city councils and are regulated by the Markets and Bus Stations Act. Regulations to enhance farmer's ability to cope with price risk will require changes to the current Markets and Bus stations Act. 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). 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. Tubende contribute to the problem of price risk by creating price distortions that exacerbate the problem of price risk for tomato farmers. 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. 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.

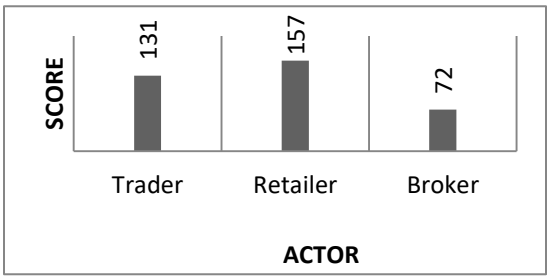

Figure 16: Scoring of actors based on trust and transparency of

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. According to Mwiinga, (2009), small-scale farmers engaged in forward contract arrangements tend to break these contracts; as such regulations governing conflict resolution in the chain in the form of court systems and third-party arbitration is required (KITT & IIRR, 2008).

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 in 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 and farmers sell their tomato produce in ad hoc spot markets. Captive and modular governance systems however, guarantee reduced information asymmetry, formal cooperation among actors, provision of 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.

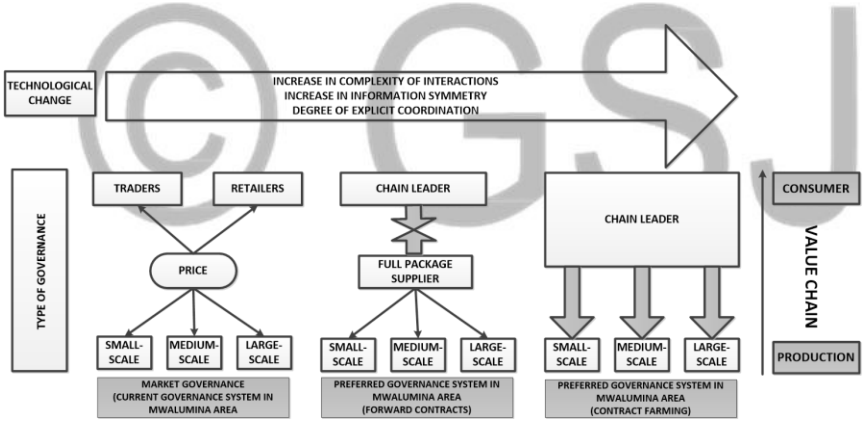

Figure17: Proposed governance systems for the reorganization of the tomato value chain

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 18 depicts a market interaction matrix showing the current position and preferred position for tomato farmers and the required interventions for horizontal and vertical integration.

Inclusion factors into a reorganized tomato value chain

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 GAP, 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. Trust-building among actors in the chain is also required as there is a high incidence of contract breach among small-scale farmers in Zambia. Louw & Jordan (2016) 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. Figure 18, shows the inclusion factors for participation in a reorganised tomato value chain in Mwalumina District.

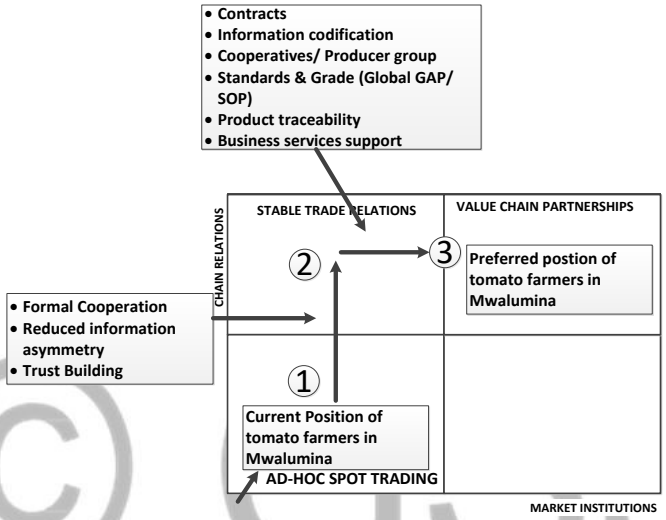

Figure 18: Market Interaction Matrix depicting preferred position tomato farmers

CONCLUSION

Its was found that the tomato value chain in Mwaumina has a market type of governance with the absence of vertical and horizontal integration activities. Farmers did not employ formal PRM strategies as such they faced price risk as a result of the price variability of tomato produce at spot markets. Crop diversification and irrigation were the predominant PRM strategies among the 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 also grew more varieties of tomato than medium and large-scale farmers. The study found also found that 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. Variety diversification therefore 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. Its was also found that is no cooperation and coordination among actors in the tomato value chain in the area. In addition the chain is characterized by a high level of information asymmetry and low level of trust and transparency. Governance changes require the introduction of captive and modular governance systems that avail reduced information asymmetry, formal cooperation, provision of business services support, information codification, product and process upgrading for actors in the Chain. 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 and market information systems. Vertical integration can take the form of contract farming, formation of cooperatives, and warehouse receipts (*in combination with cold storage*). For small-scale tomato farmers to be able to participate sustainably in a reorganized value chain however, will require education on product and process upgrading such as GAP, HACCP, SOP, Global GAP certification, and traceability.

Data Availability Statement

Data sets generated and analysed during the study are available from the corresponding author upon request.

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