The use of information sharing systems to address opportunistic behaviour between tomato farmers and brokers in Zambia

by

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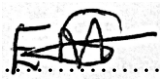
DECLARATION

I, Eustensia Munsaka, declare that the thesis, which I hereby submit for the degree MSc (Agric) Agricultural Economics at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE:…  ….. DATE: 31 May 2018

DEDICATION

To my father, Kelly Munsaka, and my mother, Evelyn Simbeleko Munsaka.

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LIST OF ACRONYMS AND ABBREVIATIONS

CPI	Consumer Price Index
FGD	Focus Group Discussion
IAPRI	Indaba Agricultural Policy Research Institute
ICT	Information Communication Technology
iDE	International Development Enterprises
KM	Kilograms
SPSS	Statistical Package for Social Scientists
SSA	Sub-Saharan Africa
USD	United States Dollar
USSD	Unstructured Supplementary Service Data
ZMW	Zambian Kwacha

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Department: Agricultural Economics, Extension and Rural Development
Study leader: Dr Melissa Van der Merwe

ABSTRACT

Small-scale farmers are often unable to profitably participate in agricultural output markets due to the challenges engendered by their inability to access agricultural market information. The main horticulture output market in Zambia, the Soweto market, is characterised by such challenges. In 2010, it was found that brokers on the Soweto market inflate fresh produce prices to extract an extra commission (hidden commission) without the farmers' consent. On the Soweto market, brokers take advantage of the existing information asymmetry to increase their financial gains when they transact with farmers by providing false price information to the farmers. The slow sales resulting from this behaviour leads to the deterioration and spoilage of tomatoes on the Soweto market. This behaviour deprives farmers of their profits and ultimately leads to reduced livelihoods of the rural population.

In an effort to enhance market information availability and access for small-scale farmers in Zambia, an information sharing system was introduced in the four largest horticultural markets in Zambia. The expectation was that the system would enable farmers to access real-time commodity prices for selected fresh produce in the four markets, thereby reducing information asymmetry. The effects of this system on different aspects of the broker–farmer relationship are, however, not yet known. This applies particularly to the

effect on the supposed opportunistic behaviour of brokers which was previously identified as a major problem for farmers who trade on the Soweto market. This study therefore aims to determine the extent to which broker opportunism (using the hidden commission as a proxy for opportunistic behaviour) in the tomato industry in Zambia might be reduced by using such information systems. In addition, a check for information spillovers from the users to the non-users of the information sharing system is conducted. The study further identifies the main information needs and the most important information sources used by the tomato farmers.

This study provides insights into how the reduction of information asymmetry achieved through information sharing systems could contribute to a reduction in the opportunistic behaviour of brokers in the horticulture supply chain. Although opportunistic behaviour studies have been conducted in other sectors, little attention has been given to addressing broker misconduct, which is a big challenge for farmers in horticultural supply chains, particularly in developing countries.

The use of information systems on a large scale is expected to significantly reduce information asymmetry in transactions. It is also expected to increase the bargaining power of farmers and reduce artificial price inflations by better-informed brokers. These more transparent transactions are expected to foster more efficient market systems and thus have a positive impact on farmers' incomes and livelihoods. These systems could, in turn, increase farmer participation in the horticultural sub-sector to ultimately contribute to agricultural and economic development in Zambia.

A total of 40 non-users of the information sharing system and 30 users have been interviewed for the study. Primary data has been collected from face-to-face individual interviews and focus group discussions, while secondary data has been obtained from the Agricultural Policy Research Institute (IAPRI) price database and the Lima Links platform (the information sharing system).

The study employs a t-test to determine the statistical significance of the hidden commission as a proxy for opportunistic behaviour for the sampled group of 30 tomato farmers who are users of the information sharing system. To compare this with opportunistic behaviour in transactions that involve non-users of the system, the same test is conducted on the sampled group of 40 tomato farmers who are non-users of the

information sharing system. The other research questions related to the spillover effects and information sources are analysed by means of descriptive statistics.

The results indicate that the use of the information sharing system, in this particular case, contributed to reducing the opportunistic behaviour of tomato brokers. It was found that the users of the information sharing system were charged a hidden commission of 5%, and it was not statistically significant. This indicates the absence of broker opportunistic behaviour when farmers have access to price information. The non-users, on the other hand, were found to be charged a hidden commission of 12%, which was statistically significant. This is indicative of opportunistic broker behaviour when farmers do not have access to price information via the information sharing system. The study found no indications of information spillovers of the information sharing system from the users to the non-users of the information sharing system. It was also found that the tomato farmers often need information about agricultural commodity prices and crop management. Lastly, the results show that the users of the information sharing system depend on mobile phone applications and radio programmes (radio networks have a wider geographical coverage than mobile phone networks) as their most important sources of agricultural information, while the non-users depend on radio programmes and brokers.

Keywords: Information asymmetry, opportunistic behaviour, t-test, hidden commission, Soweto market.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE
INTRODUCTION

1.1 Background

The horticultural industry has exhibited great potential for contributing to the achievement of development objectives, given that production and trade is predominantly in high-value crops (McCullough et al., 2008). The continued growth of the global market for horticulture has been fuelled by the increase in the consumption of fruits and vegetables (Gyan Analytics, 2014). This has consequently created market opportunities in the horticulture industry. Utilising these opportunities strongly through marketing horticulture, however, depends on possessing the knowledge and information needed to understand market dynamics (GHA, 2005).

Small-scale farmers involved in horticulture production in most parts of the world have been unable to take advantage of these opportunities, partly due to constraints resulting from opportunistic behaviour exhibited by other market players. This opportunistic behaviour mainly stems from the inadequacy of market information (creating information asymmetry[1]) and poor communication among market actors involved in agricultural production and marketing chains, especially in developing countries (GHA Team, 2005; Brown et al., 2005).

Information asymmetry plays a vital role in transactions because a transaction that exhibits information asymmetry is most likely to favour the party with more information. It may therefore lead to incomplete markets, and is considered as a type of market failure (Verbeke, 2005). According to Brown et al. (2000), Sub-Saharan Africa (SSA) is one of the regions in the world that experiences the greatest challenges in linking producers of agricultural commodities to market information.

1 Information asymmetry occurs when a party to a transaction has more information regarding the transaction than other who is engaging in that transaction does (Akerlof, 1970).

In Zambia, the horticulture sub-sector is faced with similar challenges. Finding effective and efficient markets for high-value crops such as horticultural crops is a major problem for small-scale farmers (Tschirley et al., 2011). Previous evidence has shown that information asymmetry in horticultural supply chains limits the potential to achieve financial gains that farmers might obtain from marketing fresh produce (Tschirley & Hichaambwa, 2010; Emongor & Kirsten, 2009). Brokers who act as the link between buyers and sellers of fresh produce have been cited to exhibit uncompetitive behaviour in the past (Tschirley & Hichaambwa, 2010).

A key piece of background to this study is a 2010 study by Tschirley and Hichaambwa. They found that brokers who then operated on the Soweto market, Zambia's largest horticultural market and located in Lusaka, charged a hidden commission of about 9 to 10% over and above the transparent commission[2] of about 10%. The hidden commission charged by brokers is obtained by inflating commodity prices on the market without the farmer's consent. Tschirley and Hichaambwa (2010) described this misconduct as opportunistic behaviour. Indeed, opportunistic behaviour emerges in this transaction because one party to the transaction is trying to deceitfully obtain economic benefits at the expense of the other (Williamson, 1975). Tschirley and Hichaambwa (2010) attributed this opportunistic behaviour to asymmetric price information between farmers and broker. This is because farmers (residing and farming in remote areas with limited access to market information) are often unaware of the prevailing prices of commodities on the Soweto market while brokers (as the major players on the market) always have this information.

The opportunistic behaviour of brokers results in slow sales, and farmers often incur losses or obtain very little to no profit from such transaction. This has a devastating effect on small-scale farmers' incomes and livelihoods, as they often depend on income from such activities to sustain their livelihoods. This directly affects the household resource allocation decisions on food and crop production for these farm households. (Aryeetey & Isinika, 2010).

2 This is the commission that the farmer and the broker agree on as a charge for the brokerage services provided by the commission for brokerage services. The official transparent commission is 10% of the total amount of tomato sales. It is the normal commission known by market players although it is not regulated by the market.

The situation described above is likely to impede the development of an otherwise viable horticultural industry. As stated by Williamson (1975), opportunistic behaviour acts as a barrier to successful market transactions between partners. In an effort to address market information challenges in Zambia, an information sharing system that enables farmers to access price information for their commodities was introduced in the largest horticultural wholesale markets in Zambia in 2014. Existing literature (for example, Wathne and Heide, 2000; Myhr, 2006 and Asheeta et al., 2008) indicates that farmers' access to price information through various systems/channels, including mobile phones, has been found to manage opportunistic behaviour and benefit farmers in India, Tanzania and Uganda. The current study aims to provide additional evidence of the positive impact of the use of information sharing systems through the provision of price information in agricultural output markets.

By using the hidden commission as a proxy for opportunistic behaviour, this study is able to determine the extent to which broker opportunism in the tomato supply chain in Zambia is reduced by farmers' gaining access to price information through an information system.

1.2 The transaction between tomato farmers and brokers in Zambia

Tomatoes are the most commonly grown horticultural crop in Zambia, and there are two main market channels used by horticulture farmers and traders to sell tomatoes – the traditional market system (the informal market) and the modern market system (the formalised market). Farmers and traders under the "modern" system sell produce to grocery shops, mini-marts and supermarkets (McCullough et al., 2008). In the traditional market system, farmers mainly sell through local wholesale markets, and use brokers to conduct transactions on their behalf in these wholesale markets. Farmers (sellers of produce) and traders (buyers of the produce) who use wholesale markets are almost always forced to use brokers due to the fear of not finding clients for large quantities of produce, and to ensure that their produce does not get seized or stolen in the market (due to the lack of security in the market) (Hichaambwa & Tschirley, 2010). The buyers of this fresh produce are either organisational buyers or traders (retailers) who sell on several retail markets within and outside Lusaka. The smooth functioning of the chain relies on the interrelationships among these players, and it is vital for sustaining horticultural production and achieving development outcomes.

While understanding the functioning of the modern horticultural supply chains is important, it is the less formal market, the traditional system, that is more important in Zambia. This is particularly so because over 90% of the products are sold through these traditional markets (Hichaambwa, 2010). Typically, actors in the traditional sector include farmers, traders, brokers and organisational buyers. In the traditional market, produce can be sold through wholesale markets, through farm-stalls, or directly from homesteads. Some farmers in this sector therefore transport their produce to the nearest market centres, such as the Bauleni or Soweto wholesale markets. The Soweto market, situated in Lusaka, is the biggest horticultural market centre in Zambia and is also the centre of the traditional trading sector. Other farmers that use the traditional market system mainly sell fresh produce along major highways and to individual traders who sometimes buy directly from farmers' homesteads.

The presence of brokers in Zambia's fresh produce wholesale markets is assumed to have both positive and negative effects on transactions. On the one hand, brokers play an important role in the marketing process as they facilitate market operations by linking buyers and sellers to transact. This is engendered by their ability to quickly collect supply, demand and price information, and their familiarity with both buyers and sellers. For the brokerage service, brokers receive a commission of about 10% of the total sales from each transaction. On the other hand, brokers do not usually disclose factual supply, demand or price information to either the buyers or sellers. Tschirley and Hichaambwa (2010, p44) corroborated this by stating that "without the farmers' knowledge, brokers add price mark-ups in addition to the normal broker commission". The brokers agree on the tomato price with the farmers and later inflate this price when selling to the traders, without telling the farmers, who at this point still own the tomatoes. The majority of fresh produce sellers (farmers) and buyers on the wholesale market are therefore unaware of the price that the broker agrees on with the other party. This information asymmetry is exploited by brokers who, through price mark-ups, maximise their personal financial gains from these transactions (Tschirley & Hichaambwa, 2010).

The opportunistic behaviour exhibited by tomato brokers through inflating tomato prices has negative impacts on tomato farmers' incomes, and ultimately their participation in horticultural crop production. Given the perishable nature of tomatoes, slow tomato sales result in the deterioration and spoilage of tomatoes because they remain on the market for

long periods of time. Unfortunately, the losses from tomato spoilage and deterioration as a result of the inflated prices are borne by the farmers. This is because the brokers do not take ownership of the tomatoes, but rather get their 10% commission from the total sales. The farmers who produce these tomatoes therefore face bigger losses; they end up losing out by earning very little to no profits. For small-scale farmers, such losses ultimately lead to severe financial and social hardships because small-scale farmers are, by definition, resource-poor (Richards, 2002).

1.2.1 The information sharing system on the Soweto market in Zambia

The Lima Links information sharing system (referred to as the "information sharing system" in this study) was developed by the International Development Enterprises (iDE) Zambia in August 2014. The information sharing system was developed to enable farmers to access real-time market prices for horticultural products, to enhance informed decision-making capacity about crop production and marketing, and to reduce their marketing risks and uncertainties.

The data on the system is captured from brokers. Brokers on the wholesale markets where the information sharing system was rolled out were trained to use the data input interface of the information sharing system. This involves entering information on the type of product, price, and quantity for every transaction they conduct. The average price of each type of commodity for each market is calculated by the system. This information is accessible to end users for free through the Unstructured Supplementary Service Data (USSD) interface by dialling *789# on an Airtel sim card.

Monitoring was done to ensure that brokers entered the true prevailing prices, and a study which was conducted to determine if the brokers were entering the correct information confirmed that the information was correct (Hichaambwa & Munthali, 2015). The price entered in the information sharing system is the real price (wholesale price) at which a commodity is sold. This means that farmers who use this system are able to tell if the first seller price (the price agreed on with the broker) is different from the wholesale price. The implication of this is that the farmers are able to detect if their broker has inflated the price, and then engage in bargaining to reach alternative price.

1.3 Problem statement

The lack of access to price information by farmers renders them vulnerable to brokers' opportunistic behaviour in the Soweto market. Goyal (2010) asserts that the lack of price information poses greater challenges for market actors in upstream stages of supply chains, such as farmers. This high level of farmer vulnerability is partly attributed to the lack of exposure to reliable market information that other (downstream) supply chain actors have access to (Goyal, 2010). The market dynamics discussed above shape the type of relationships that develop between supply chain actors, and constitute a critical aspect for efforts aimed at tackling opportunism in supply chains.

The introduction of the information sharing system in market environments is likely to prevent brokers from behaving opportunistically. Mobile phone-based information sharing systems have been particularly highlighted by previous studies in this regard. We have also seen countries such as Uganda and Bangladesh use mobile phones in agricultural markets to improve the efficiency of agricultural markets by increasing market information availability and access (Jensen, 2007; Asheeta et al., 2008; Martin, 2010; Courtois & Subervie, 2014). This kind of intervention was found to have worked in the northern region of Ghana, as indicated by Courtois and Subervie (2014). Courtois and Subervie's (2014) study found that the opportunistic behaviour of agricultural commodity traders during the price bargaining process with farmers was deterred by farmers' access to price information. The Phalliathyna initiative in Bangladesh worked in a similar way to the information sharing system introduced on the Soweto market in Zambia. Asheeta et al. (2008) reported that the Phalliathyna system effectively reduced broker exploitation of farmers. However, it remains unclear whether such interventions in Zambia have been effective in addressing supply chain challenges, such as broker opportunistic behaviour.

The lack of empirical evidence on this subject in Zambia indicates that opportunism in horticultural markets has not been sufficiently analysed, especially in developing countries. Very little is understood about the effectiveness of interventions required to restrict opportunism among supply chain players at the stage of horticultural supply chains that link farmers to markets. In fact, Tschirley and Hichaambwa (2010) assert that there is a need for analysis to be focused on exploring the behaviour of brokers when dealing on these markets, and its effect on the horticultural market in Zambia. The hidden commission

charged by brokers creates a basis for concern regarding the possible opportunistic behaviour of brokers (Tschirley & Hichaambwa, 2010).

The question of whether there have been changes in the behaviour of brokers, in light of increased transparency in market transactions on the Soweto market, deserves further discourse and explanation. This will provide an illustration of the effectiveness of market information sharing systems as tools to reduce broker opportunism. The issues addressed by this study may ultimately shed light on strengthening the farmer–broker relationship by managing broker opportunism to encourage farmer participation in horticultural markets. The study furthermore aims to contribute to the information required for policy and programmatic decisions regarding appropriate interventions required to improve the performance of the domestic horticultural supply chain in Zambia. This is expected to have a significant impact in enhancing growth in Zambia's agricultural sector through increased participation of farmers in profitable agricultural markets and the effective functioning of agricultural markets.

1.4 Objectives

This study's primary objective is to determine the effect of mobile phone market information systems on the behaviour of tomato brokers on the Soweto market in Zambia.

The specific objectives of the study are to:

- Determine the perceptions of the users and non-users of the information sharing system regarding the behaviour of tomato brokers.
- Determine whether the use of the mobile phone information system has reduced the hidden commission charged by Zambian tomato brokers since the last study in 2010.
- Determine if there have been information spillovers of the mobile phone information sharing system from the users to the non-users of the system.
- Identify the main information needs and important information sources used by the tomato farmers.

1.5 Theoretical framework and hypotheses

According to Hichaambwa and Tschirley (2010), the tendency of tomato brokers to obtain hidden commission was mainly attributed to the existing information asymmetry in the Soweto market; the lack of commodity price information as well as information about tomato supply and demand on the market. This means that brokers have the upper hand in negotiations when transacting with farmers. Introducing an intervention that solves the major issues of information asymmetry is expected to reduce the hidden commission problem, to a certain extent.

According to Wathne and Heide (2000), opportunistic behaviour can be managed by reducing information asymmetry. Van der Merwe et al. (2017) supports this argument: they found that information sharing among farmers (in farmer networks) and with the downstream supply chain entities abattoir resulted in a reduction of opportunistic behaviour by farmers. When it comes to the opportunistic behaviour exhibited by other market players when dealing with farmers, studies show that providing price information or market information, in general, reduces opportunistic behaviour (Myhr, 2006; Asheeta et al., 2008)

Therefore, the reduction of information asymmetry resulting from the availability of price information through the information sharing system is expected to constrain the tendency of obtaining hidden commission by brokers. With access to the information sharing system, farmers would be aware of the prevailing tomato prices in specific markets. This means that the brokers would not be able to inflate tomato prices without the knowledge of the farmers, who are the users of the information sharing system.

> **Hypothesis 1:** *The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who use the mobile phone based information sharing system.*

Further, there have not been any major changes (since the introduction of this system) in terms of the platforms available for horticulture farmers to access price and market information in Zambia. There have not been other interventions similar to the information sharing system; hence, the introduction of the information sharing system may have been the first of such interventions. Intuitively, it would be expected that there would be no

significant reduction of the hidden commission charged to farmers who did not use the information sharing system.

> **Hypothesis 2:** *The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are not equal for the farmers who do not use the mobile phone based information sharing system.*

Oftentimes, people or groups that are not directly targeted by particular interventions may nevertheless still be affected by them. Several studies in different economic sectors have analysed the spillover effects of various interventions, such as deworming in the health sector in Kenya (Miguel & Kremer, 2004), cash transfer programmes in the social protection sector (Angelucci & De Giorgi, 2009) and female voter awareness programmes in rural Pakistan (Giné & Mansuri, 2011). All these studies provided some evidence of information spillovers.

In a normal market setting, farmers that trade within the same vicinity will most likely interact and share information at a certain point, especially information concerning their business in the market. At most, it is expected that there would be some information diffusion between the two groups of farmers; the users of the information sharing system; and the non-users. At least, it is expected that the non-users would be aware of the existence of the information sharing system and the type of information it provides. This information may relate to price information obtained by the users from the information sharing system, the benefits they experience due to the use of the information sharing system, or any other noteworthy information regarding the information sharing system.

This study hypothesised that the information about the information sharing system would be shared by the users, and possibly be used by the non-users to obtain benefits similar to those obtained by the users, if any. That is, non-users might acquire market information obtained by users without directly using the system themselves. Therefore, as an indication of the presence of spillovers, it was expected that the hidden commission for the non-users would also be reduced, although probably not to the same extent as the reduction for the users.

> **Hypothesis 3:** *There is diffusion of information regarding the mobile phone information sharing system from the users to the non-users of the system.*

Given the discussion above, the conceptual framework presented in Figure 1.1 was used to guide this study.

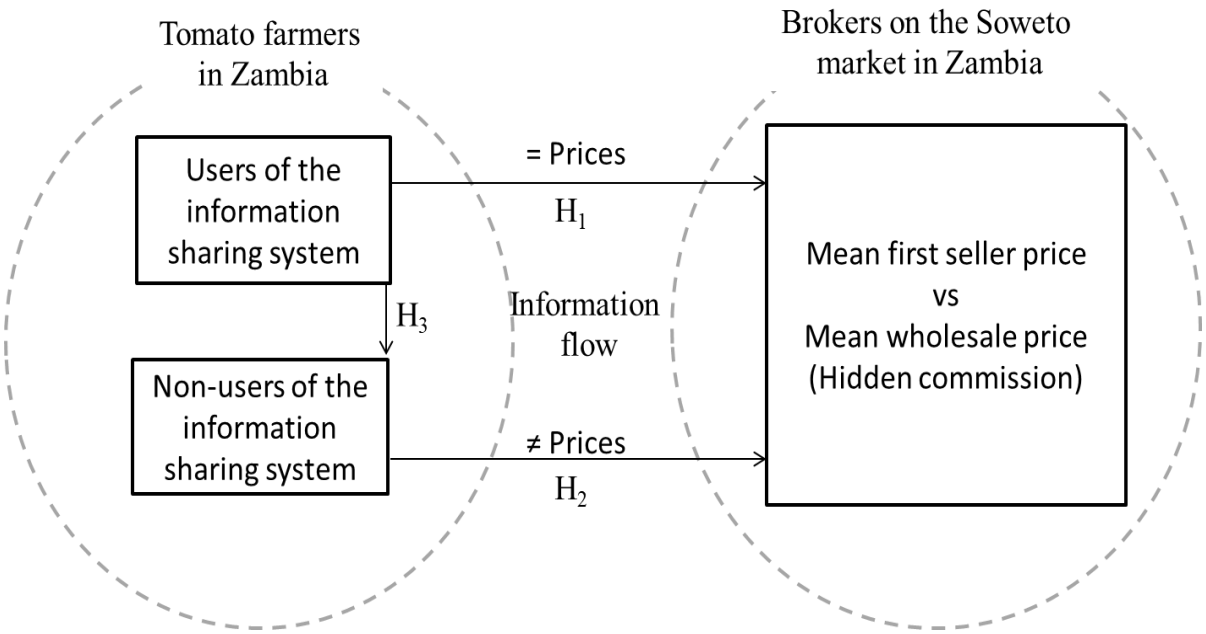

Figure 1.1: A conceptual framework for analysing broker opportunistic behaviour

1.6 Methodology

1.6.1 The context of the study and data sources

The Soweto market in Zambia was the target market for this study and was appropriate in this case because it is the biggest horticultural market in Zambia (Mwiinga, 2009). It is situated in Lusaka, Zambia's national capital, as indicated on the map in Figure 1.2.

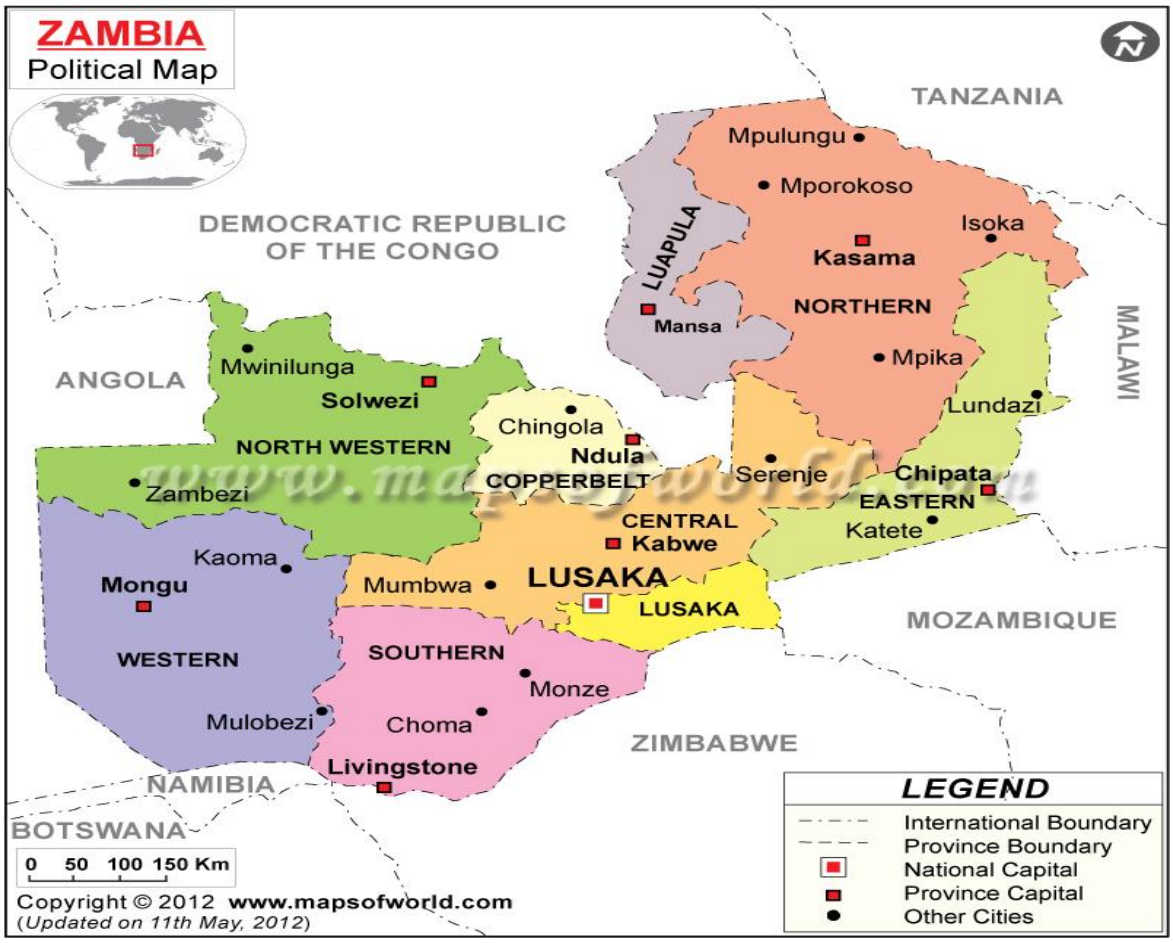

Figure 1.2: Information sharing system user groups by gender

Source: Mapsoftheworld.com, 2012.

The current study specifically focused on the relationship between tomato farmers and their brokers. The decision was based on evidence from a previous study that highlighted the negative effects of opportunistic behaviour on farmers involved with brokers on the Soweto market (Hichaambwa & Tschirley, 2010). In addition, tomatoes were specifically focused on because they are the most commonly traded fresh produce in the Soweto market (Mwiinga, 2009).

1.6.2 Sampling methods

Convenience sampling was used as the sampling method. More specifically, a walk-in method which involved approaching tomato farmers randomly as they entered the Soweto market to deliver tomatoes to brokers. This same approach was followed by Hichaambwa and Tschirley (2010) in a similar study. Convenience sampling is easy to conduct, and sampling requires relatively little time and low costs to carry out. This relatively low cost

and ease make it the preferred choice for a large proportion of academic studies. Due to the biases that are inherent in convenience sampling, because the sample may not be representative of the larger population under the study, the generalisation of the results obtained may be undermined (Park, 2009; Hogg & Tanis, 2005).

T-tests are typically used for analyses aimed at determining the statistical significance of the difference of two means (Zabell, 2008). Although there are different views about the optimal sample size for t-tests in cases where the size of the sampling frame is unknown, it is well known that t-tests were developed for small sample sizes (Lehmann, 2012; de Winter, 2013). However, it is still not clear where to draw the line between "large" and "small" samples (Zabell, 2008). Several studies (for example Welch, 1958; Zabell, 2008; Lehmann, 2012; de Winter, 2013) have in the past used t-tests on very small sample sizes (samples of 5). While de Winter (2013) found that t-tests can be used on sample sizes lower than N=5, the most common assertion in the literature is that a sample size of at least 30 cases per group is recommended (Cohen, 1990; Rhiel & Chaffin, 1996; Boos & Hughes-Oliver, 2000; Hogg & Tanis, 2005).

In light of this, the current study planned to use the commonly recommended minimum sample size of 30 users of the information sharing system and 30 non-users, with the possibility of interviewing up to 40 respondents for each group to account for possible unforeseen response and attrition challenges. To that end, a total of 40 non-users were interviewed for the study. Unfortunately, only 30 users of the information sharing system could be interviewed for the study because the tomato farmers using the information sharing system were very few in number.

1.6.3 Data collection and instruments

Both primary and secondary data were used to address the research objectives. To compute the hidden commission for each group of tomato farmers (the users and the non-users of the information sharing system), two sets of prices were required per group. The wholesale price, which is the actual price at which brokers sell tomatoes, and the first seller price, which is the price at which the farmer and broker agree to sell the tomatoes.

To compute the hidden commission for the users of the information sharing system, the wholesale prices were collected from the Lima Links platform (the information sharing system). To compute the hidden commission for the non-users of the information sharing system, the wholesale prices were sourced from the Agricultural Policy Research Institute (IAPRI) 2017 price database. The first seller prices used here were collected from the users of the information sharing system using the questionnaire (see Appendix A, page 101). Similar to the users, the first seller prices for the non-users of the information sharing system were also collected from the non-users by using the questionnaire. All the data details used were for the same period of time, June–July, 2017.

The questionnaires (Appendix A, page 101) were administered in July 2017 to the 30 users of the information sharing system and 40 non-users, using face-to-face interviews, and were administered by the author who was assisted by a research assistant. A face-to-face interview involves an interviewer administering a structured/semi-structured questionnaire in person to a respondent for a specific period of time (Lyberg & Kasprzyk, 1991). This is typically used when conducting surveys involving very large populations at the national or regional level, in marketing/consumer surveys, or in ad hoc research studies. Collecting data using face-to-face interviews has the advantages that it has very good sample properties because it typically involves collecting data for a large number of people, and it is relatively easier to administer the questionnaire because the questions are often standardised. In addition, when face-to-face interviews are utilised, there is certainty about who the respondent was, and the respondents are not under pressure to only provide answers that are socially acceptable (Holbrook et al., 2003). However, face-to-face interviews are very costly; they make it relatively easier for the respondent to be dishonest as there is typically not much probing involved; and respondents may not be able to remember some required information without others to assist (De Leeuw, 1992).

The questionnaire was not only used to collect first seller tomato prices, but also to collect other data used in the analysis. This data includes data on sources of agricultural information used by farmers, data regarding farmers' perceptions about broker behaviour, farmer–broker conflicts, and farmers' knowledge of the information sharing system and its use.

In addition to the face-to-face interviews, focus group discussions (FGDs) were conducted. The FGDs were used to collect the data that was used to determine the perceptions of the

users and non-users of the information sharing system on the tomato brokerage system. As asserted by Morgan (1998), FGDs can also be used to clarify findings obtained by other data collection methods. As such, FGDs were also used to better understand some of the findings from the individual face-to-face interviews, and specifically to get more information on broker competitiveness and the renegotiation between brokers and farmers when tomato sales were slow. Six FGDs (with 36 farmers in total) were conducted in a shelter near the Soweto market, two weeks after the face-to-face individual interviews were conducted (in July, 2017). Three groups of 6 tomato farmers represented users of the information sharing system, and three groups of 6 represented non-users (36 farmers in total). The participants of the FGDs were selected from the pool of farmers that were surveyed in the face-to-face interviews. The FGDs were conducted using an interview guide (see Appendix B, page 107). Some of the issues that were discussed in the FGD include issues about the bargaining between farmers and brokers, and the issues about the renegotiation process. Also discussed was the perception of the farmers about the competitiveness of the brokers on the market.

Like other data collection methods, FGDs have both advantages and disadvantages. Krueger and Casey (2014) indicated that the main advantages are that FGDs allow for follow-up questions that probe for more-detailed explanations and it easier to understand FGD data than complicated statistics. Other advantages are that it is quicker to collect data from a large number of people using FGDs, compared with individual interviews, FGD participants may facilitate each other's thinking and build on each other's ideas, and FGDs enable a researcher to observe non-verbal responses such as facial expressions (Powell & Single, 1996). The disadvantages of FGDs are: the FGDs groups may be too small to represent the larger population; discussions are not easy to control, hence time may be wasted on irreverent topics; and some FGDs participants may shy away from expressing their opinions, especially when they are not in line with the views of the other FGDs participants (Bertrand, 1992).

1.6.4 Data analysis methods

The various methods that were used for analysis in the present study are presented in this sub-section. Both quantitative and qualitative analyses were required to adequately address the research objectives of this study. In addition, qualitative data was required to better

understand and confirm some of the results that were obtained from the quantitative analysis. Therefore, various methods were used, as required, to adequately address each specific objective and for triangulation purposes.

The qualitative analyses that were conducted mainly focused on the data obtained from the FGDs. The FGDs were conducted after scanning the data obtained from the survey questionnaire that was administered to the users and the non-users of the information sharing system using face-to-face interviews. This provided some guidance for conducting the FGDs and made the discussions more focused. From this process, broker competitiveness and the price renegotiation process between brokers and farmers were identified as the main focus themes for the FGDs. Broker competitiveness on the Soweto market was analysed using Porter's Five Forces Model. Michael Porter proposed five forces that affect the level of competitiveness in an industry (Porter & Millar, 1985). These five forces include the threat of new entrants to the marketplace, the threat of substitute products, the bargaining power of suppliers within the industry, and the bargaining power of buyers. Porter and Millar postulate that an industry's key economic characteristics can be identified by analysing how it is affected by suppliers, buyers, rivalry, substitution, and barriers to entry.

The test for opportunistic behaviour was conducted in two steps. Firstly, the mean hidden commission was determined, and then the statistical significance of the hidden commission was determined using a t-test. A statistically significant hidden commission indicates the presence of opportunistic behaviour, while the opposite indicates the absence of opportunistic behaviour.

Below is the formula for the t-test (McDonald, 2008):

$$t = (\bar{X}_1 - \bar{X}_2) \Big/ \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

t = t statistic

$\ddot{X}i$ = Sample mean for the i-th sample (i=1,2)

S^2_i = Sample variance for sample i

n_i = Sample size for sample i

With regard to identifying information spillovers, the main interest was to determine the diffusion of the innovation (information sharing system) in question. The analysis that was done was based on the assumption that information diffusion, if present, could be detected through its effect on the hidden commission of non-users of the system. Further, a question was included in the survey questionnaire for non-users of the system to elicit information indicating diffusion of information about the information sharing system among the farmers.

The Statistical Package for Social Sciences (SPSS) was used to analyse the data collected from the survey. The identification of the most important information sources used by the tomato farmers was conducted in two stages, and Excel spreadsheets were used to carry out this exercise. Firstly, the individual interviews conducted were used to derive a list of information sources by asking the farmers to list the most important agricultural information sources. After identifying the main information source, pairwise ranking was used to identify the important information source used by the tomato farmers. Pairwise ranking is a qualitative analysis method often used in systematic investigations of preferences and priorities in communities (Russell, 1997).

All the information sources mentioned by the farmers were then used to conduct the pairwise ranking exercise during the FGDs in order to rank the information sources, as prioritised by the farmers. This data was consolidated to derive the ranking by the users of the information sharing system and the second ranking by the non-users,

1.7 Justification of the study

Existing literature concerning opportunism in supply chains mainly focuses on opportunistic behaviour among downstream supply chain actors. These studies mainly focus on supply chain performance attributes, such as information asymmetry and transaction costs. Although the opportunistic behaviour of brokers remains a challenge for small-scale farmers that participate in the horticultural industry in Zambia, studies to analyse this behaviour have been limited. In fact, Hichaambwa and Tschirley (2010) explicitly expressed concerns about the opportunistic behaviour of brokers on the Soweto market in Zambia, and recommended more focused research to address this. However, there have not been any studies that address this concern.

Although an information sharing system was rolled out in order to increase transparency in transactions, questions remain as to what the implications of this market information sharing system are and the extent of consequent increased transparency on broker opportunistic behaviour on the Soweto market. Understanding these dynamics is a necessary prelude to any discussions and effective interventions that involve encouraging farmers to participate in horticulture production and marketing in Zambia.

1.8 Outline of the thesis

The next section (Chapter Two) introduces the main concepts used in the study. It also explores the literature related to opportunistic behaviour in agricultural markets, the use of information sharing systems in agriculture, and information spillovers. Chapter Three provides detailed information about horticulture production, the tomato industry, and the tomato market channels in Zambia.

Chapter Four presents the results of the study, starting with descriptive statistics of the characteristics of the sampled farmers. Next, the results from the analysis of the relationships between farmers and farmers' perceptions of the information sharing system are presented. This is followed by the hypotheses testing (using t-tests) to determine whether the hidden commission for each group was statistically significant. Then follows the results on information diffusion, information needs and sources of agriculture information used by tomato farmers. The last part of the report is the conclusion and recommendations section (Chapter Five), which provides a summary of the study, together recommendations based on the findings of the study.

CHAPTER TWO
OPPORTUNISTIC BEHAVIOUR, INFORMATION SHARING, AND INFORMATION SPILLOVERS IN AGRICULTURAL MARKETS

2.1 Introduction

This chapter examines the literature that offers useful insights for understanding the present study. In this regard, a vast array of studies have been conducted, in various academic fields, illustrating the role of brokers in agricultural markets and exploring opportunistic behaviour, as well as how these affect operations and transactions in organisations and markets. Possible opportunism deterrence mechanisms have been proposed and analysed by various research streams. Also discussed in this chapter are studies involving the use of mobile phones in improving the performance of agricultural markets. To gain a more realistic understanding of this analysis, this study borrows some New Institutional Economics (NIE) concepts, specifically from Agency Theory and Transaction Cost Economics Theory, to explain certain attributes of the transaction and the supply chain relationship under consideration.

2.2 Brokers in agricultural markets

2.2.1 Role of brokers in agricultural markets

Brokers (also referred to as market agents or commission agents) are market actors that assist other market actors in effecting transactions by connecting sellers to buyers of commodities/products without taking ownership of these commodities (Tschirley & Hichaambwa, 2010). Their compensation is obtained from either actual sales, often stated in terms of the percentage of transaction price (Nagalakshmi et al., 2013) or a fixed rate for each quantity transacted (Gabre-Madhin, 2001).

Sustaining broker linkages with other market actors requires credible relationships that acknowledge the need for the survival of all parties involved in a transaction (McCullough et al., 2008). These relationships are considered to be long term because the majority of brokers in agricultural markets work with the same traders/farmers over a long period of

time (Gabre-Madhin, 2001). The sustainability of this relationship requires that both brokers and farmers mutually benefit from the transactions they conduct with each other. Difficulties faced by farmers at this point may result in negative ramifications on farmer participation in horticultural markets. This consequently creates adverse effects on the whole supply chain because unsustainability on the farmer's side has negative implications on the entire supply chain system (Ryu et al., 2008).

Previous studies (see Gabre-Madhin, 2001; Nagalakshmi et al., 2013; Hichaambwa & Munthali, 2015) suggest that specific roles played by brokers may differ slightly for each agricultural supply chain, although their basic function is to contribute to improving market efficiencies by minimising transaction costs. The transaction costs involved here are costs incurred when buyers and sellers are searching for each other, searching for market information, and coordinating the transactions. These costs can be significant in some cases, such as in the Ethiopian grain market where they represent one-fifth of the total marketing costs (Gabre-Madhin, 2001). According to Tschirley et al. (2011), there may be certain circumstances where farmers rely highly on existing trading systems where the role of brokers is seen to be essential. Such circumstances include a situation where farmers incur huge transaction costs searching for buyers for their commodities or price information on the market. In such cases, it is more appropriate to place emphasis on the improvement factors such as market information access. This can be done through existing trading systems to assist markets to operate efficiently, as opposed to assisting farmers to bypass market actors such as brokers.

Apart from matching buyers and sellers, Gabre-Madhin (2001) states that brokers among Ethiopian grain traders also inspect grain shipments and provide market information to grain traders whom they provide brokerage services to. Brokers are especially important to regional wholesalers in these supply chains. This is because the wholesalers find it difficult to sell grain to traders in distant locations without the assistance of brokers (Dessalegn et al., 1998). Therefore, wholesalers at a regional level need certain brokerage services more than those who trade locally do. Services provided by brokers, for example collecting market information such as contact details of several local traders, are more important to regional traders who cannot easily do it themselves due to their distant locations. Other services include collecting money from the local traders after they sell the grain and sending it to wholesalers. Gabre-Madhin's (2001) findings indicate that wholesalers were

indeed behaving rationally by deciding to use brokers to minimise information search costs and that the use of brokers was economically efficient.

2.2.2 Opportunistic behaviour by brokers in agricultural markets

While previous literature has noted the relevance of brokers, the credibility of brokers in agricultural supply chains has been criticised by a number of researchers (see Steele & Scott 1987; Jagun et al., 2007; Muthini, 2015) who have illustrated the tendency of brokers to take advantage of other market players. Jagun et al. (2007) claim that brokers play an important role in Nigeria's *Aso Oke*[3]. However, they are in the habit of syphoning most of the profits because neither the weavers nor the buyers have complete information of the other's transaction with the broker. The brokers keep some of the money from the buyers and under-pay the weavers, who end up losing out from the transaction. Similarly, Steele and Scott (1987) claim the same about brokers in Peru's potato supply chain. Brokers in potato markets earn excessive profits at the expensive of potato farmers, who end up not realising their entitled profits from selling their potatoes.

Muthini (2015) asserts that the Kenyan mango markets, which are infiltrated by brokers who withhold some market information from mango producers, are characterised by price manipulation and control by these brokers. This information asymmetry leaves farmers with very little bargaining power, resulting in large losses for them. In South Africa, formalised groups such as the South African fresh fruit and vegetable market brokers have also been suspected of behaving opportunistically by forming price-fixing cartels (Khumalo, 2017). Price fixing has negative implications, not only for farmers but also other market players and consumers. Prices that result from price fixing particularly affect vulnerable households who already spend a high percentage of their income on food. Price fixing has an anti-competition aspect, in that co-conspirators drive out their competitors when they fix very low prices that other businesses in the market cannot sustain. This is usually done by larger players in an industry who connive to keep out emerging businesses (Levenstein et al., 2003).

3 A major cloth-weaving industry with a well-developed supply chain.

In a study closely linked to the current study, Tschirley and Hichaambwa (2010) analysed the role of brokers on the Soweto fresh produce wholesale market in Zambia. They determined the level of hidden commission for several vegetables sold at the Soweto market by comparing the first seller price with the observed retail price of the vegetables. Additionally, they conducted a survey among a combination of first sellers (farmers and other traders) to collect information about the relationship between brokers and these first sellers. The study returned mixed findings, indicating both negative and positives aspects of the presence of brokers in the market. While brokers sometimes provide valuable services, they force farmers to sell through them by posing threats concerning the security of their produce. When they do sell farmers' produce, they often add hidden commission when selling the sellers' produce. Also highlighted was the inadequacy of formal regulatory and enforcement mechanisms for brokering activities. The authors further recommended that more focused research to be undertaken regarding the behaviour of brokers. The current study follows up on this by focusing on the opportunistic behaviour of brokers

2.3 Understanding Opportunistic behaviour

2.3.1 Contextualising opportunistic behaviour

Opportunistic behaviour is a concept that has been defined and analysed in various research streams, including New Institutional Economics. Attention was given to the opportunistic behaviour phenomenon when Williamson (1975) coined opportunistic behaviour as "self-interest seeking with guile". It includes subtle and less deliberate actions such as free riding, as well as deliberate ones such as making false promises and misrepresenting intentions. Williamson (1985) later defined guile as "lying, stealing, cheating, and calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse". Harriss et al. (1995) extend Williamson's definition of opportunistic behaviour and explain that it does not include honest disagreements between partners, which are viewed as the rational type of self-interest. However, it includes self-interest behaviour with motivational and not cognitive origins, to act dishonestly in order to achieve one's personal goals while disadvantaging the other party to the transaction, often without the other party's knowledge (Wathne & Heide, 2000).

To enhance the understanding of opportunistic behaviour and put it into context, other studies specifically use the agency theory lens to analyse opportunistic behaviour. According to Delves and Patrick (2008), Agency Theory, as proposed by Stephen Ross and Barry Mitnick in the 1970s, looks at opportunistic behaviour occurring in an agency relationship. The agency relationship is characterised by conflicting interests between the principal and the agent in the face of information asymmetry (Mitnick, 2013), in the sense that the agent's[4] behaviour is not entirely known by the principal[5] (Groenewegen et al., 2010). Harriss et al. (1995) described the principal–agent problem as a situation where an agent finds some room to behave opportunistically, which happens because there is a cost associated with revealing the behaviour of the agent to the principal.

The different forms in which opportunistic behaviour is manifested mainly fall into either of the two broader themes of Agency Theory, that is adverse selection and moral hazard. Adverse selection occurs when, before an economic exchange agreement, an agent deliberately withholds relevant information from the other party, about his skills or condition (Huque, 2005; Amagoh, 2009). Moral hazard occurs when an economic actor acts dishonestly after a transaction agreement when the principal cannot observe all his actions (Hobbs, 1996). Other terms used to refer to adverse selection are ex-ante opportunism and pre-contractual opportunism; similarly, ex-post opportunism and post-contractual opportunism are sometimes used to refer to moral hazard (Huque, 2005). However, there are other forms of opportunistic behaviour that cannot necessarily be categorised as adverse selection or moral hazard. The opportunistic behaviour of tomato brokers in the current study can be categorised under moral hazard. This is because the brokers act opportunistically by inflating tomato prices after agreeing on the transaction terms with the farmers.

The study of opportunistic behaviour has broadened over the years while being applied to the analyses of dyadic transactions in several fields of study. Studies conducted illustrate the manifestation of opportunistic behaviour in various types of transactions. Regarding public–private partnerships (PPP), Qu and Loosemore (2013) state that opportunistic

4 An agent is the person in a transaction who makes decisions or acts on behalf of another person (the principal).

5 The principal is the party that delegates another party to conduct a task which they themselves are either not willing, or not able, to do it.

behaviour is revealed in forms of false and unrealistic promises made by bidders in order to win PPP contracts. Management studies by Ramaswami et al. (1997) and Jaworski (1988) use the term 'dysfunctional behaviour' to explain the opportunistic behaviour of subordinates in a firm. Ramaswami et al. (1997) studied a situation in which employees manipulated the firm's appraisal system because they were aware that it was based on incomplete information. They used gaming[6], smoothing[7], focusing[8] and invalid reporting[9] to create positive impressions of their performance to receive beneficial treatment from the company management.

2.3.2 Causes of opportunistic behaviour

There is a broad array of literature explaining the circumstances under which market actors such as brokers would behave opportunistically. Generally, both in agriculture and other sectors, experts agree that information asymmetry plays an important role as a determinant of opportunistic behaviour in transactions. Ryu et al. (2008), in the agricultural sector, and Steinle et al. (2014), whose study was based on a cooperate firm, identified information asymmetry as one of the major factors that cause opportunistic behaviour. Similarly, Seager et al.'s (2007) study about causes and implications of opportunism in the cooperate sector concludes that, while factors such as asset specificity and task complexity contribute to agent opportunistic behaviour, information asymmetry is the major cause. John (1984) and Wathne and Heide (2000), who focused on the marketing industry, were of the view that information asymmetry creates a suitable environment for opportunistic behaviour to thrive. According to Wathne and Heide (2000), information asymmetry concerning one party's attributes in a transaction is a condition that facilitates opportunistic behaviour, as it creates a type of vulnerability that limits the other party's ability to detect that behaviour.

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6 **Gaming** – employee manipulation of control systems to favour them. It involves expending more effort on tasks that highly affect performance measures used by the control system, while ignoring those tasks that have very little effect on performance measures.

7 **Smoothing** – giving management signals of a consistent performance pattern which may not be true.

8 **Focusing** – deliberately directing a superior to positive information and overstressing its consequences, then drawing the superior's attention away from negative information.

9 **Invalid reporting** – intentionally inputting incorrect data into the control system.

This gives the party a chance to behave opportunistically without getting caught (Kirmani & Rao, 2000).

2.3.3 Restricting opportunistic behaviour

The most apparent effect of opportunistic behaviour in a transaction is that uncertainty about the transaction increases, often leading to an increase in transaction costs (John, 1984; Dahlstrom & Nygaard, 1999). In an effort to reduce this uncertainty, parties to the transaction may opt to search for more information about each other or about some other aspects of the transaction. The search for market information involved here comes at a cost, involving financial investment in the search activities, as well as the opportunity cost of time and working capital (Gabre-Madhin, 2001).

Because economic transactions vary widely in nature, the proposed methods of attenuating opportunistic behaviour depend on the type of transaction under consideration (John, 1984). However, the commonly recommended deterrence mechanisms for information-related opportunistic behaviour involve the use of mechanisms that increase transparency in transactions (Wathne & Heide, 2000), such as monitoring mechanisms. In fact, Nagin et al. (2002) have stated that monitoring is one of the common tools for deterring opportunistic behaviour. Wathne and Heide (2000) further suggested that the general purpose of monitoring is to reduce information asymmetry. Grover et al. (2002) reinforce this point by claiming that the effective monitoring of an agent will minimise the probability of him engaging in deceitful behaviour without the principal being aware of it. Additionally, Delves and Patrick (2008) asserted that the actions of an actor in an economic exchange can be restricted using monitoring mechanisms and incentives, which they describe as “policing mechanisms”.

In terms of empirical evidence, Pascual-Ezama et al. (2013) found that monitoring an agent in a transaction reduces cheating (shirking). However, Gabre-Madhin (2001) demonstrates an interesting situation in which monitoring broker behaviour proved to have been unnecessary. This is a study in which traders monitored brokers’ activities in the Ethiopian grain market, where the relationships among market actors are reputation based. Gabre-

Madhin (2001) found that broker opportunistic behaviour was controlled by well-established norms that were incentive-compatible[10]. The main elements of these norms were: (i) the absence of market-making[11]; (ii) charging flat commissions; and (iii) sharing of information about broker behaviour through a joint client system which involves farmer-to-farmer communication. Therefore, in the presence of effective informal institutions, formal monitoring mechanisms may be unnecessary.

Contrary to the results of Pascual-Ezama et al. (2013) mentioned above, Ghoshal and Moran (1996) argued that monitoring and incentivising may, in some cases, increase the likelihood of opportunistic behaviour. Shirouzu and Bigness (1997), Murry and Heide (1998), and Huque (2005) support this argument by asserting that monitoring the behaviour of agents may be used and viewed in an antagonistic manner by the agent. The effect of this is that the agent may try to find loopholes in the monitoring mechanism. An example of this can be illustrated by Joseph and Thevaranjan (1998). Their study focused on a salesforce control system where both monitoring and incentives were used to control opportunism in sales organisations. The results indicate that being monitored induced the salesforce to expend their efforts on those performance dimensions that were monitored, while concentrating less on unmonitored dimensions. In this case, an incentive in form of a payment was provided to the workforce to encourage increased effort and discourage them from looking for other ways to cheat the system. This was done because monitoring alone did not necessarily solve the problem of opportunism in the control system.

In cases where monitoring worsens the outcome of a transaction, the problem probably lies in the methods or tools used to monitor agents, because human beings, to a large extent, respond to being monitored by maintaining honest behaviour. For instance, in a situation where a monitored agent looks for other ways to shirk, implementing a monitoring system that covers all the relevant aspects of the task at hand could impose enough restriction to prevent deceptive behaviour. As such, the suggestion by Bradach (1997) and Brown (2000) to manage opportunistic behaviour through the simultaneous use of various forms of monitoring and enforcement mechanisms can be viewed to be more realistic because these

10 When the incentives that motivate the actions of market actors are consistent with following the established rules in the trading environment.

11 Market-making involves the facilitation of transactions by brokers who deal with both buyers and sellers of a commodity. Market-makers benefit by quoting both buyer and seller prices; they are willing to buy commodities,

mechanisms have differential impacts that can be taken advantage of. This suggestion is likely to be more useful in reality because real-world problems are multidimensional and complex (Joseph & Thevaranjan, 1998). Unfortunately, such mechanisms may be too costly to implement and use.

Makeche (2016) also conducted a study involving opportunistic behaviour in agriculture. She specifically analysed the behaviour of private maize traders in Zambia when dealing with smallholder farmers and the factors that influence their behaviour. The study found that these traders did indeed behave opportunistically and that their behaviour was influenced by their trading experience and their level of education. In light of this, the study suggested that opportunistic behaviour, in such a case, could be reduced by training the less-experienced and less-educated traders.

A study that is more closely related to the current one in terms of looking at opportunistic behaviour in agricultural supply chains was conducted by Van der Merwe et al. (2017). It was a study on using information sharing as a safeguard against the opportunistic behaviour of Karoo Lamb (a niche lamb product with a unique taste) farmers in South Africa. The study found that information sharing among farmers (in farmer networks) and with the abattoir resulted in a reduction of opportunistic behaviour among farmers. They also concluded that joint action against opportunistic farmers might be an effective means for dealing with opportunistic behaviour among farmers.

Keeping to joint action against opportunistic farmers, Boadi et al. (2007) suggested disintermediation as a solution for dealing with intermediaries that often behave opportunistically. Disintermediation involves cutting off intermediaries from the transaction. In Ghana, this was done by creating an m-commerce[12] platform, which is an online market where sellers and buyers find each other and conduct transactions. According to Boadi et al. (2007), this system has worked for some farmers and fishermen in Ghana. The farmers and fishermen used m-commerce to bypass middlemen who often exhibit opportunistic behaviour. Although this system seems to be working, there was no information to illustrate the details of their transactions. Other economic implications of this system on the output markets involved were also not evaluated. Furthermore, the

12 Mobile commerce (m-commerce) is the sales of goods and services via mobile devices such as mobile phones, tablets, other types of smart devices (Clarke III, 2001).

concept of m-commerce to deal with opportunistic behaviour has not been thoroughly analysed to determine how practical and sustainable it is, especially in agricultural markets that involve perishable commodities such as horticulture produce.

2.4 Information access in agricultural markets

It is important to acknowledge that farmers require information to make well-informed production decisions and to protect themselves against the opportunistic behaviour of others in the process of marketing their commodities. Kameswari et al. (2011) conducted a study to analyse the information needs of small-scale farmers. According to their study, farmers' information needs can be categorised into the know-how, contextual information, and market information stages. The *know-how* stage is when farmers need technical information about crop and seed variety choices, usually required before planting, to assist farmers to decide on the type of crops to plant. The second stage is the *context stage*, and the information required by farmers during this stage is information about the weather, plant protection, and cultivation practices. This is required during the crop production process to assist farmers with cultivation and crop-management decisions. Finally, in the *market information* stage, farmers need information about market prices, demand and other market logistics (Kameswari et al., 2011). Unfortunately, farmers in developing countries such as Zambia do not have adequate access to this type of information when it is required, and in the form in which it is required.

The importance of information availability in agriculture has been widely written about, particularly through the use of information and communication technologies (ICTs). Donner (2008) indicated that accessing information through ICTs is key to economic growth, more so for developing countries with resource-constrained business environments (Donner, 2008). The role played by information availability in the efficient operation of markets has been highlighted by several scholars for a long time. The Forum for Agricultural Research in Africa (FARA) (2009) states that various economic sectors in the past decade have experienced a surge of information, and ICT has become an important tool in agriculture as it has now assumed a significant role in facilitating the sharing of market information, thereby increasing market transparency (Martin, 2010). In an earlier study, Muendo et al. (2004) mentioned that market information plays a decisive role in all

agricultural supply chain transactions, and it is one of the key elements for increasing market transparency and enhancing economic gains for each supply chain entity.

De Silva et al. (2008) linked information asymmetry with production costs incurred by farmers. According to the study, information asymmetry prompts a party to a transaction, such as a farmer with inadequate market information in this case, to search for more information concerning the transaction in question. The results showed that this information search forms a major part of the transaction costs commonly incurred by small-scale farmers in Sri Lanka's largest wholesale agricultural market. They found that 70% of the transaction costs incurred by these farmers were information-related costs. The study linked this to farmers' production costs and found that the information-related costs translated to about 15% of the production costs. This suggests that information asymmetry may negatively affect agricultural production and marketing.

The lack of market information in agriculture is, however, a widely recognised problem (Jayne & Shaffer, 1998; Ngugi et al., 2006; Molony, 2008; Goyal, 2010; Ahlers et al., 2013). Jensen (2007) acknowledged that market performance, efficiency, and welfare are likely to be improved by ICT; but emphasised that optimal gains from economic exchange in different types of markets are impeded by limited or costly information. Contrary to the notion that access to information may be relatively costly, Aker (2010) states that there is a wide range of very low-cost tools to access information systems available. Tools, such as mobile phones, are easily accessible and yet equally as effective as other more expensive tools to access information systems.

As stated above, there is a wide range of ICT-based information sharing systems that are used in agriculture. Information can be made available to farmers through technologies that have been traditionally used, such as televisions and radio, as illustrated by Svensson and Yanagizawa (2009). Then, there are modern forms of technology, such as mobile devices, computers, and the internet, which can be used in different ways to disseminate information. For instance, information on the internet can be accessed using different devices, including computers and 'smart' mobile phones. Internet kiosks have been used to provide information on soybeans prices, farming techniques and the weather to farmers in Madhya Pradesh State in India (Goyal, 2010). In terms of smart mobile phones, apart from gaining access to many information sources via the internet, agricultural information can

be made available on mobile phones through voice/video phone calls, SMSs, and mobile phone applications. At the agricultural productivity end, modern technology is being used to access a huge amount of information, such as highly detailed weather and climate information, through the use of GPS, satellite and drone monitoring (Bendre et al., 2015).

As in most developing countries, Zambia's economic sectors have been using information technology (IT) increasingly to share a great deal of information (Zambia Information and Communication Technology Authority, 2015). Extensive and rapid market-information sharing in Zambian markets has previously been facilitated by the use of the most basic mobile phones. This is because a sufficiently large proportion of Zambian households have access to basic mobile phones. In rural areas, 50.4% of households have at least one member of the household with a phone, compared with a high 84.8% of households in urban areas. With regard to network coverage, 98.9% of individuals in urban areas and 83.9% in rural areas have network coverage in their areas of residence (Zambia Information and Communication Technology Authority, 2015). Moreover, the Government of Zambia intends to provide services that will promote access to agricultural market information and the use of ICTs. This involves the development and operationalisation of a mobile phone, SMS-based extension service platform. The idea here is to provide exactly the information that extension workers currently provide, except that SMSs will be used to send it to the farmers.

2.5 The use of mobile phones as a source of information

2.5.1 Sourcing market information

There are a number of studies about the use of mobile phones to improve efficiencies in agricultural value chains in developing countries. The use of mobile phones may reduce information asymmetry in agricultural markets. This has been associated with the reduction of opportunistic behaviour taken towards farmers, and therefore increasing the bargaining power of farmers engaging in transactions with other market actors (Myhr, 2006; Asheeta et al., 2008). Other experts, such as Muto and Yamano (2009), indicate that increasing information flow through mobile phone use is expected to reduce the price of agricultural commodities in markets, especially in markets where prices are artificially inflated due to a lack of price information.

A system that best illustrates how the use of mobile phones can be used to reduce the opportunistic behaviour of brokers in an agricultural market is the Palliathya initiative in Bangladesh (Asheeta et al., 2008; Lannon, 2012). The Palliathya initiative is a mobile phone helpline that was set up in order to cheaply provide access to agricultural information services in four districts in Bangladesh. The Palliathya initiative provides various types of agricultural information that is considered to be relevant to the local farmers. The information shared includes price information. It has been highlighted as being an example of a mobile phone-based information system that has managed to reduce information gaps and prevent the exploitation of farmers by brokers.

The exploitation of farmers, or opportunistic behaviour of other market actors, occurs in many more transactions than those explicitly stated by literature. Farmers are often exploited in transactions when the party they are engaging with possesses more information about the prevailing market prices and market demand than the farmers do. This imbalance of power creates an incentive for the other party to misinform the farmer about the price in order to get a better deal. However, the incentives to act opportunistically by misinforming the farmers are lowered when the farmers become better informed. On average, the farmers receive relatively fair prices for their commodities if they are aware of the prevailing market prices. This, therefore, gives the farmers a stronger bargaining position. In such a case, there is opportunistic behaviour involved, and it is restricted by the farmers' access to information (Svensson & Yanagizawa, 2009).

The situation described above has been explained by a number of studies that found that access to market information played an important role in enhancing the bargaining power of farmers (for example, Myhr, 2006; Svensson & Yanagizawa, 2009; and Courtois & Subervie, 2014). Courtois and Subervie (2014) analysed the effect of farmers' access to price information on farm-gate price bargaining between traders and farmers through a mobile phone-based Market Information System (MIS). Initially, traders would provide false price information during the bargaining process in order to pay lower prices for the commodities. Traders could behave opportunistically because they had access to market price information, while the farmers did not. With this false information, the farmer would lose out, as traders would pay lower prices. When the MIS was introduced, farmers were able to access price information and bargain for higher prices when dealing with traders. It was found that those who benefited from the MIS received higher prices (10% for maize

and 7% for groundnuts) than they would have if they did not participate in the MIS programme.

Similar to Courtois and Subervie (2014), a natural experiment involving a Market Information Service (MIS) project in Uganda was examined by Svensson and Yanagizawa (2009). They found that local traders were restricted from behaving opportunistically in farm-gate transactions with farmers. This was attributed to farmers accessing market information through the MIS. Similar results were found by Myhr's (2006) study, which determined that acquiring fish price information by fishermen via mobile phones in Tanzania increased their bargaining power.

Other authors (for example, Jensen, 2007, and Aker, 2008) have analysed at the effect of using mobile phones in agriculture by focusing their studies on a specific commodity. Jensen (2007) conducted an empirical study on the fish industry in India, which exhibited high levels of price dispersion across markets. Mobile phones enabled fishermen to obtain price information and compare prices across various markets. Knowing this, traders realised that they could no longer exploit the fishermen, since they could now check the actual market price of fish. The findings indicate that the use of mobile phones by fishermen and wholesalers, apart from resulting in a reduction in price dispersion (from between 60% and 70% to 15%), also resulted in the elimination of the daily catch waste and in the Law of One Price[13] being almost perfectly adhered to by traders. Additionally, the welfare of consumers and producers increased; it was determined that while there was a 4 % decrease in consumer prices and a 6% increase in sardine consumer surplus, fishermen experienced an average profit increase of 8 %.

Aker (2010) similarly analysed how price dispersion across markets is affected by mobile phone use, specifically focusing on the Niger grain market. The study revealed that mobile phone use led to a price dispersion reduction of 16% to 10% between 2001 and 2006. In addition, Aker (2010) compared his findings with Jensen (2007) and highlighted that the use of mobile phones has a greater effect on market performance for more perishable commodities than on less perishable ones. This is because Aker (2010), dealing with grain

13 "Law of One Price" states that "the price of a good should not differ between any two markets by more than the transport cost between them" (Jensen, 2007).

(a less perishable commodity), evidently found a lower magnitude of the effect of mobile phones on reducing price dispersion compared with the magnitude of the effect found by Jensen (2007), who focused on fish (a highly perishable commodity). Price information is more important for handling commodities that are more perishable because farmers dealing with perishable commodities depend highly on brokers. They cannot store produce when prices are low, which renders them much more vulnerable, as brokers know that farmers would rather accept a low price than risk losing the product. Given that the current study focused on tomato, a perishable commodity, a similar impact is expected from the use of the information sharing system. Muto and Yamano's (2009) findings support this claim. Their findings revealed that the increased flow of information, attributable to expansion in mobile phone coverage, had a high impact on banana sales, and no impact on maize sales.

Others scholars (see, *inter alia*, Abraham, 2008; Martin, 2010; and Hichaambwa & Munthali, 2015) illustrate the multi-dimensional effect of information sharing in agricultural markets by slightly diverting from directly focusing on commodity prices. Martin (2010) studied the use of mobile phones among small-scale farmers in Uganda and found that the majority of farmers used mobile phones mainly to access and coordinate markets and agricultural input information, as well as to monitor activities such as financial transactions and emergencies related to agriculture. Abraham's (2008) study on the Indian fish industry had similar findings as Jensen (2007), but also highlighted other impacts of using mobile phones. The study found that the time and resources required to search for fish were reduced as fishermen started using mobile phones to inform each other of the presence of fish. In addition, given that fish is a highly perishable commodity, fast information flow via mobile phones reduced the risk and uncertainty of fish marketing, leading to a reduction in losses.

The findings by Camacho and Conover (2010) were, however, somewhat different from the results of the studies that indicate positive effects of the use of mobile phones on the performance and/or welfare of farmers in agricultural markets. Camacho and Conover (2010) aimed to determine the effect of receiving price and climate information by farmers via text messages (SMS) in Colombia. The study reported mixed findings on the effect of using an information sharing system in agriculture. It was found that price dispersion was reduced, as in other studies described above, and that crop loss was reduced by the weather information received by farmers. However, the results indicated that the final prices of

commodities were not reduced by the use of this system. Furthermore, receiving the SMSs did not have any effect on incomes or expenditure of farmer households. As with the current study, Camacho and Conover (2010) hypothesised that receiving information via the SMS system would have a positive effect on the various aspects under consideration in their study. The explanation that was given for the results obtained was that the study was conducted too early in the stages of implementation of the intervention; hence, some effects or impacts might have required a longer period of time to have an effect on prices and farmer incomes.

2.6 Information spillovers

In the research and development (R&D) field, Steurs (1997) has defined technological spillovers or knowledge spillovers as "the involuntary leakage, as well as, the voluntary exchange of useful information about technological information". This has been seen in various interventions in different economic sectors, such as deworming in the health sector in Kenya (Miguel & Kremer, 2004), cash transfer programmes in the social protection sector (Angelucci & De Giorgi, 2009) and female voter awareness programmes in rural Pakistan (Giné & Mansuri, 2011). Grossman and Helpman (1992) explained this further by stating that these spillovers refer to information that is obtained by people that have not paid for it in a transaction. In addition, the creator or source of the information has very little control of the utilisation of this information by others.

Hildebrandt et al. (2015) determined the impact of a system involving rural farmers receiving commodity price information via text messages and found a positive effect of the system on the prices received by the farmers who used the system. Additionally, they found that there were spillovers (indirect benefits) to the non-users of the system (control group). These spillovers appeared a few months after the intervention began and continued to increase over time.

There are various reasons why spillovers for some interventions could be of interest. Sometimes, it may be essential to determine the sustainability of a particular programme. Other times, it may be relevant to determine the indirect benefits of an intervention for policy decisions. For instance, Miguel and Kremer (2004) illustrate how spillovers may be used for making policy decisions. Miguel and Kremer (2004) evaluated a programme

which involved providing a few schools with deworming drugs (the intervention) in Kenya. The intervention was associated with reduced absenteeism and improved health. This was observed in both the treatment and neighbouring schools. These results indicated large externalities of the intervention to the extent of influencing policy. This led to the provision of fully subsidised deworming treatments among school-going children, based on the findings from the initial programme.

Similarly, the present study was particularly interested in the horizontal diffusion of information[14] about the information system sharing in the Soweto market. There might also be a horizontal diffusion of the price information obtained from the system between the system users and non-user interviewed, which the study referred to as "information spillovers".

2.7 Conclusion

The literature explored in this section underscores the problem of opportunistic behaviour and how it thrives in the presence of information asymmetry. It shows that brokers may play important roles in certain markets, although they might sometimes take advantage of this information asymmetry to exploit farmers. Literature about restricting opportunistic behaviour was reviewed, and several studies indicated that there are various information sharing systems that can be used to address opportunistic behaviour. Some of the information systems are based on providing price information to farmers through mobile phones, while others involve information sharing amongst farmers themselves.

It has been well illustrated that opportunistic behaviour can be deterred through the use of an information sharing mechanism by providing examples of systems that have worked in Tanzania and Bangladesh. Further, there is a large and growing body of literature and empirical studies revealing that there are increased efforts in the use of ICTs to provide market information in agricultural markets. The majority of the studies mainly focus on price dispersion between markets, with little analysis being made of the economic

[14] Diffusion of information among supply chain players at the same stage of a supply chain – for example, between users and non-users of the information sharing system.

relationships between market players within the markets. These relationships, such as the farmer–broker relationship on the Soweto market, are equally as important.

Tschirley and Hichaambwa (2010) identified the problem of broker behaviour in Zambia and this has not been analysed to determine the kind of intervention required to reduce such behaviour in Zambia's horticultural supply chain. To fill this gap, this study has aimed at contributing to the body of literature that indicates the importance of information sharing systems in addressing opportunistic behaviour in the horticulture.

Finally, the literature review has indicated that policy decisions can be made to support certain interventions that exhibit positive spillovers.

CHAPTER THREE
THE HORTICULTURAL SUB-SECTOR IN ZAMBIA

3.1 Introduction

This chapter discusses the horticultural industry in Zambia, and provides a brief background of the tomato industry, the main marketing channels, and the current status of these channels. An overview of the tomato industry in Zambia is necessary for understanding the importance of tomatoes in Zambia's agricultural sector, and for the evaluation of the challenges still faced by farmers, even after the implementation of the Lima Links information system.

3.2 An overview of the horticultural industry in Zambia

In Zambia, the horticultural industry has exhibited great potential for contributing to the achievement of development objectives. An estimated 21% of smallholder farmers participate in horticultural value chains, and, given that most horticultural products are of high value, there is scope for attaining development objectives if it can be improved (McCullough et al., 2008; Hichaambwa et al., 2015). In recent times, the production of horticultural products in Zambia has been largely led by smallholders; commercial production and exports have declined sharply, owing to the exit of major firms operating in the industry. This is because of rising costs of production, tightening standards requirements in the European Union market, and high transportation costs (see Mwansakilwa et al., 2013).

Imports of horticultural commodities are largely made in times of stress to smoothen prices, and also for commodities that are in short supply or the quality of which is not locally available (Mwansakilwa et al., 2013). Supermarkets are the largest importers of horticultural commodities, such as apples, strawberries, and plums.

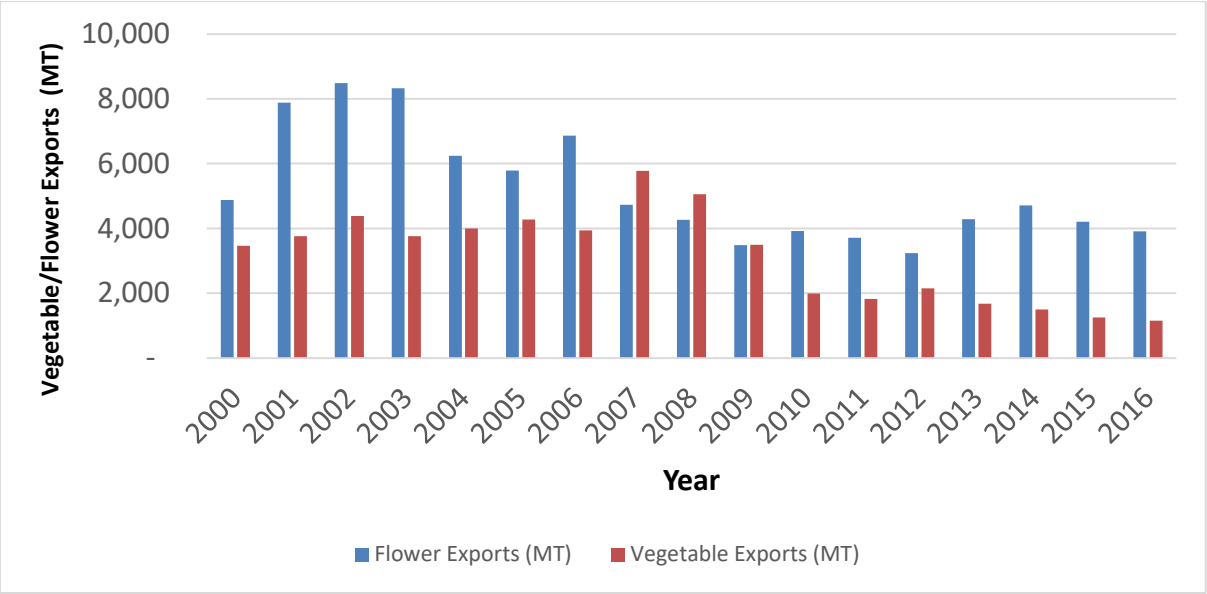

Figure 3.1: Trends in flower and vegetable exports (2000 – 2006)

Source: Zambia Export growers Association

Table 3.1 below presents production and sales statistics for horticultural crops produced by smallholder farmers in Zambia. Typically, the smallholders cultivate up to 20 hectares of cropland. In the case of vegetables, the average monthly production is 67,000 metric tons (RALS, 2015). The main fruits and vegetables produced can be categorised into the traditional and exotic. The exotic category includes commodities such as tomato, rape, onion, cabbages, Chinese cabbage, and lettuce. On the other hand, traditional fruits and vegetables include pumpkin leaves, cassava leaves, and sweet potato leaves. In recent times, there has been an increase in the local production of fruits such as apples and strawberries; however, the actual production is unknown, as data is not collected for these fruits. The production value among smallholders is estimated at 792[15] million Kwacha for fruits, and 585 million Kwacha for vegetables. About 65% of the marketed produce comes from the Central, Northwestern, Southern and the Copperbelt provinces. Most of the produce produced by these farmers constitutes exotic vegetables at 72%, with traditional vegetables only accounting for 16% of total production, while fruits are at 12% (Hichaambwa et al., 2015).

[15] 1USD = 10.ZMW

Table 3.1: Production and Sales of Fruits and Vegetables among Smallholder Farmers

	Total value produced/sold by type in Million Kwacha							
			Vegetables					
	Fruits		Exotic		Traditional		All three types	
Province	Produced	Sold	Produced	Sold	Produced	Sold	Produced	Sold
Central	13	8	153	114	10	5	176	128
NorthWestern	5	2	44	27	70	66	119	95
Southern	5	3	88	71	9	8	101	82
Copperbelt	8	7	79	64	3	2	90	73
Eastern	20	10	78	51	10	5	108	66
Lusaka	10	6	37	34	5	5	53	45
Northern	4	2	33	29	4	4	41	35
Luapula	24	8	17	10	6	4	48	22
Western	4	2	25	18	2	1	31	21
Muchinga	5	4	15	11	5	4	25	19
Total	99	53	569	430	124	102	792	585

Source: Hichaambwa et al. (2015)

3.3 Tomato market channels in Zambia

Tomatoes constitute a key horticultural crop that is utilised by almost all households in cooking, and they account for the largest budget share (0.1%) of the total fruit and vegetable expenditure of both wealthy and poor households in Zambia (Mwiinga, 2009). Similar to other horticultural products, tomato production in Zambia is carried out by small-, medium- and large-scale farms, with the large-scale farmers producing about 35%, the medium-scale farmers 33%, and small-scale farmer producing 24% of the total tomato production among farmers in Zambia (Mwiinga, 2009).

Figure 3.2 sets out a schematic presentation of the tomato marketing systems in Zambia. Two major marketing systems exist, namely the modern market system and the traditional market system. The modern market system is more formalised and comprises the large corporate firms/processors such as Freshmark, Freshpikt and Rivonia. Freshmark accounts for 0.9% of tomato wholesale volumes, and it purchases tomatoes from large-scale Zambian farmers. In cases where local farmers fail to meet demand, the firm imports from Freshmark South Africa. Freshpikt and Rivonia produce processed tomato products and have tomato wholesale shares of 8% and 0.1%, respectively. On the other hand, Rivonia is a local processor that procures tomatoes from local Zambian farmers and also imports tomato paste to make their sauces. Freshpikt produces its own raw tomatoes and uses them

as a major ingredient in producing products such as baked beans, tomato paste, and tomato puree. The processed tomato products and raw tomatoes from the modern sector are procured by large supermarkets and grocery mini-marts across the country.

The traditional market system consists of farmers, traders, brokers and organisational buyers. As the main horticultural wholesale market, the Soweto market controls 79% of the total tomato wholesale volume, and transactions in the traditional market system are centred on it. Other smaller wholesale markets within Lusaka, such as the Bauleni market, have a wholesale share of about 5% of total tomato sales, by volume. This is mainly supplied to households, other open-air markets, and small informal retail outlets (including street vendors, market stands, and small rudimentary stores). Some 7% of the wholesale tomato volumes are supplied straight to these retail outlets from farmers (mostly small-scale farmers).

On the other hand, the supply of tomatoes to the Soweto market is done by small-, medium-, and large-scale producers, either directly or indirectly through traders. Typically, producers supplying the Soweto market are located in the Lusaka and Central Provinces of Zambia. The main supply channels at the market include individuals, organisations, open-air markets, retailers from within and outside Lusaka, and small and informal retail outlets. In other parts of Zambia, farmers produce relatively small quantities of tomatoes, which they sell to traders at the farm-gate or supply directly to retailers at the local markets.

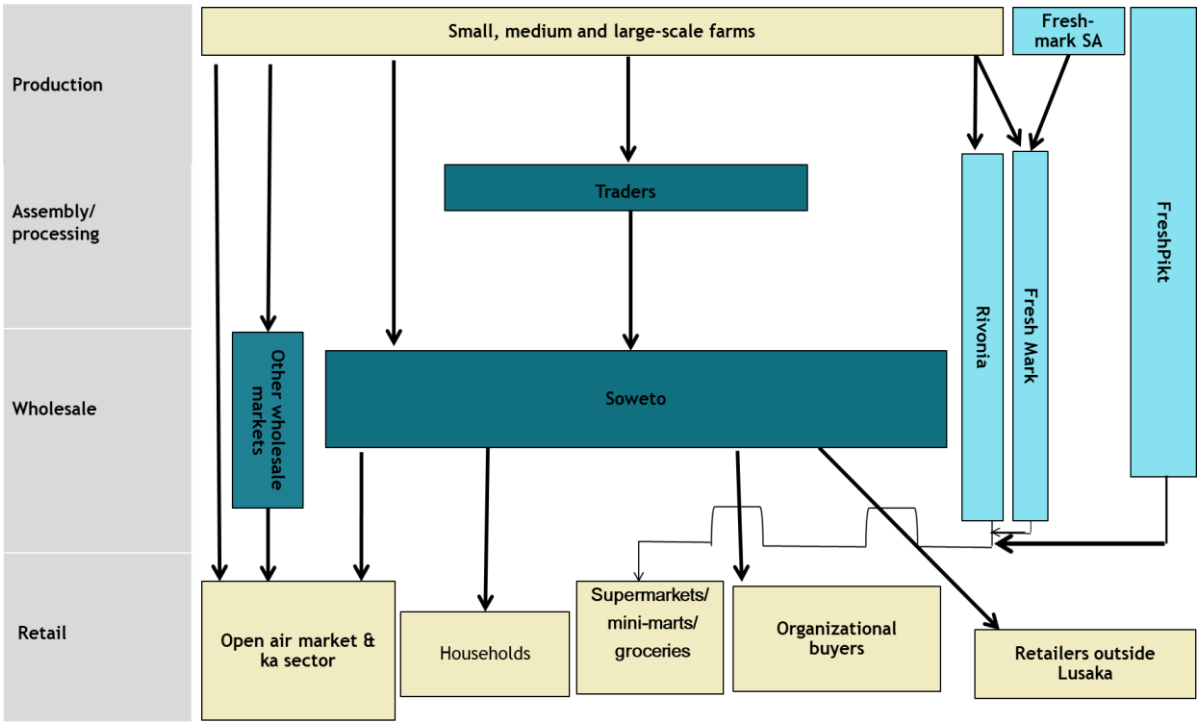

Figure 3.2: Channel map of the main tomato marketing system in Zambia

Despite the fact that the Soweto market is a key marketing channel for tomatoes in Lusaka district and Zambia, evidence from other studies suggests that other marketing channels may be more beneficial to tomato producers. Emongor and Kirsten's (2009) findings indicate that the incomes of small-scale farmers were positively affected by the participation of the farmers in the supermarket channel. They found that Zambian farmers who participated in the fruit and vegetable traditional markets had incomes that were significantly lower than those of farmers who participated in the supermarket channel. This can be viewed from two perspectives. On one hand, the Zambian supermarket sector has, in recent years, continued to emerge, vibrantly. The number of local tomato producers that have manage to get contracted to supply produce for supermarkets has increased. On the other hand, the increase is relatively low, as very few farmers are able to access and sustain such arrangements or contracts because of issues such as supply consistency, consistent high quality and food safety concerns, and traceability requirements. An additional source of concern for farmers comprises the transaction costs that arise due to participating in vertical coordination arrangements with supermarkets. Of particular concern is the cost of negotiating the terms of the agreement and the enforcement of the signed contract (particularly following up on payments) with other parties to the agreement.

From the farmers' perspective, these challenges are barriers to gaining access to more lucrative and stable markets (Mwiinga, 2009). Naturally, farmers will flock to markets with low barriers, like the Soweto market, that they can easily access. This natural tendency to seek out markets with the lowest barriers to entry leads to there being a high percentage of tomato farmers that depend highly on traditional market channels.

In the traditional market system, at wholesale market centres such as the Soweto market, farmers sell their produce through brokers. Farmers and traders who use wholesale markets are almost always forced to use brokers for the fear of not finding clients for their large quantities of produce, so as to ensure that their produce does not get seized or stolen in the market (Hichaambwa & Tschirley, 2010). Therefore, as a tomato farmer, being associated with a broker provides physical security. The buyers of this fresh produce are either organisational buyers, such as hospitals and non-governmental organisations (NGOs), or traders who export produce to other areas outside Lusaka. The smooth functioning of the chain relies on the interrelationships among these players, and it is vital for sustaining horticultural production and achieving development outcomes.

As in most markets, the operations of the Soweto market are supposed to be guided by formal institutions (rules and regulations) by means of the Zambian Marketing Act (Mwanaumo, 1999). From an economic perspective, the rules and regulations of interest, in this case, are those that affect the competitiveness of the market players. These include the rules against forming cartels, rules against the use of coercion by any market players when conducting transactions, and the regulation that involves the setting of a standard broker commission of 10% of the total sales for each transaction. The enforcement of these regulations, however, remains weak. This, unfortunately, places brokers in control of the market operations. When it comes to the broker commission, although it is 10%, on average, it may be slightly higher or lower, depending on the agreement between a broker and a particular farmer. It may be slightly higher when a farmer has large volumes of tomatoes to be traded, or lower for farmers with very small quantities of tomatoes to be sold.

A market transaction between a tomato farmer and a broker illustrates a typical transaction on the Soweto market. Tomato brokers on the Soweto market have more information about market prices, compared with the tomato farmers that they provide brokerage services to. They obtain financial benefits from their transactions with farmers by not declaring the real

price at which they sell tomatoes to retailers and organisational buyers on the wholesale market. They obtain the difference between the first seller and wholesale price (hidden commission) and still get their 10% commission from the amount declared to the farmer (Hichaambwa & Tschirley, 2010)..

The inflation of tomato prices by brokers on the wholesale market often slows down tomato sales. Because of this, tomatoes are often kept on the market for long periods of time. Unfortunately, due to the high perishability of tomatoes, this often leads to deterioration and spoilage. Since brokers do not take ownership of the tomatoes, the risks and associated losses of spoilage and deterioration are incurred by the farmers. When the tomatoes deteriorate and spoil, brokers are unable to sell them at normal market prices. The tomatoes then have to be sold at a much lower price, as compared with the initial price. This calls for a renegotiation process with the farmer who owns the tomatoes (Hichaambwa & Tschirley, 2010). . This negotiation often leads to a new lower price for the deteriorated and (semi) spoiled produce of lower quality. The renegotiated price is usually much lower than the initial price, and the farmer ends up not making the anticipated profit or, at times, makes a loss. Since horticulture, especially tomato production, is a capital-intensive enterprise and poor farmers strive to acquire the resources required for it, making losses becomes a colossal financial strain. As such, the opportunistic behaviour exhibited by brokers is likely to discourage farmers from producing commodities for horticultural markets.

As noted above, and in Chapter Two, horticulture marketing transactions involve high risks and uncertainty for farmers due to inadequate or a complete lack of access to market information in general, and price information, in particular. In an effort to address challenges faced by farmers concerning the lack of access to market information, the Lima Links information sharing system was introduced in several horticultural markets in Zambia.

3.4 The Lima Links information sharing system

The Lima Links information sharing system (referred to as the “information sharing system” in this study) was developed by International Development Enterprises (iDE) Zambia in August 2014. The information sharing system was developed to enable farmers

to access market information, including price information, in order to enhance their bargaining position in the transactions they engage in and to reduce their marketing risks and uncertainties. The information sharing system was rolled out in four main horticultural wholesale markets in Zambia, the Soweto market (Lusaka district), the New Kasanda market (Kabwe district), the Chisokone market (Kitwe district), and the Masala market (Ndola district). Brokers (on the wholesale markets mentioned above) were randomly selected and trained to use the web interface of the information sharing system by entering information regarding the transactions they conducted.

For every transaction conducted, the brokers enter the type of commodity and quantity traded, as well as the unit price of the commodity. The average price of each type of commodity for each market is calculated by the system and this information is accessible by the end user through an Unstructured Supplementary Service Data (USSD) interface. The USSD communication protocol, available on every phone, is a system that enables phone users to access various types of information, such as checking for airtime balance by dialling a number sequence, such as *141#. End users of the information sharing system are able to access price information using this method, and this service was free, with the most basic mobile phones having the capacity to be used to access it.

The farmers that were first approached to register to use the information sharing system were randomly selected (by the implementers) in the markets (mentioned above) where the information sharing system was implemented. However, no other efforts were made to create awareness or sensitise others about the information sharing system.

3.5 Conclusion

This chapter has provided information about the structure of the Zambian horticultural subsector and the tomato industry. It has been highlighted that horticultural production has recently been led by smallholder farmers whose production value is estimated at K792 million (ZMW) for fruits and K585 million (ZMW) for vegetables. However, commercial production and exports of horticultural products have been declining. Additionally, a detailed description and illustration of the tomato marketing channels has been provided, what is clear from this description is the important role played by the Soweto market in the tomato industry in Zambian. More details are provided about the Soweto market in relation

to the interaction between the tomato farmers and tomato brokers that trade on the Soweto market.

This chapter also explains how tomato brokers behave opportunistically and therefore, underscores the need for the Lima Links information sharing system that is being considered in this study. Lastly, more details are provided about the information sharing system and how it is used.

CHAPTER FOUR
THE EFFECTS OF THE INFORMATION SHARING SYSTEM ON THE OPPORTUNISTIC BEHAVIOUR OF TOMATO BROKERS

4.1 Introduction

The essence of this chapter is to present the analysis and the results of the present study. The socio-economic characteristics of the tomato farmers are presented, as well as the results from the analysis of the relationships between farmers and farmers' perceptions of the information sharing system. More results then follow from the analysis of broker competitiveness and the renegotiation process. Also presented are details of the tomato price information for the tomato farmer groups of interest, and the test for opportunistic behaviour. The last section of this chapter provides results on information needs and the important sources of agricultural information used by tomato farmers.

4.2 Socio-economic characteristics of tomato farmers

The average age of the respondents was found to be 39 years old. These are medium- and small-scale farmers located in farm areas, such as Lusaka West and the Manyika area, with an average distance of 44 kilometres from their farms to the Soweto Market as shown in Table 4.1. On average, the surveyed farmers have been farming for about 12 years. Incidentally, 12 years is also the average number of years that the surveyed farmers have been having been trading on the Soweto market. The fact that Zambian tomato farmers have been trading in the Soweto market for as long as they have been implies that the Soweto market is, and has been, their primary trading channel for many years.

Table 4.1: Socio-economic characteristics of tomato farmers

Variable	Average	Minimum	Maximum	Standard deviation
Age (years)	39.36	20	59	10.36
Farming experience (years)	12.37	2	37	8.8
Distance from homestead to Soweto market (km)	44.09	7	69	26.56

The data revealed a highly homogenous group of farmers in terms of gender, as the majority of the farmers under survey were male. Figure 4.1 below shows that the group of users of the information sharing system comprised 83.3% males and 16.7% females, while the non-user group comprised 97.5% males and only 2.5% females. These findings are consistent with several other studies (see Tschirley et al., 2012; Djurfeldt et al., 2013; Malapit et al., 2014) that have indicated a low participation by women in agricultural marketing or sales activities. For example, Tschirley et al. (2012) found that, compared with other African countries, Zambia had a much lower participation rate of females participating in horticulture marketing at the wholesale level, particularly as first sellers.

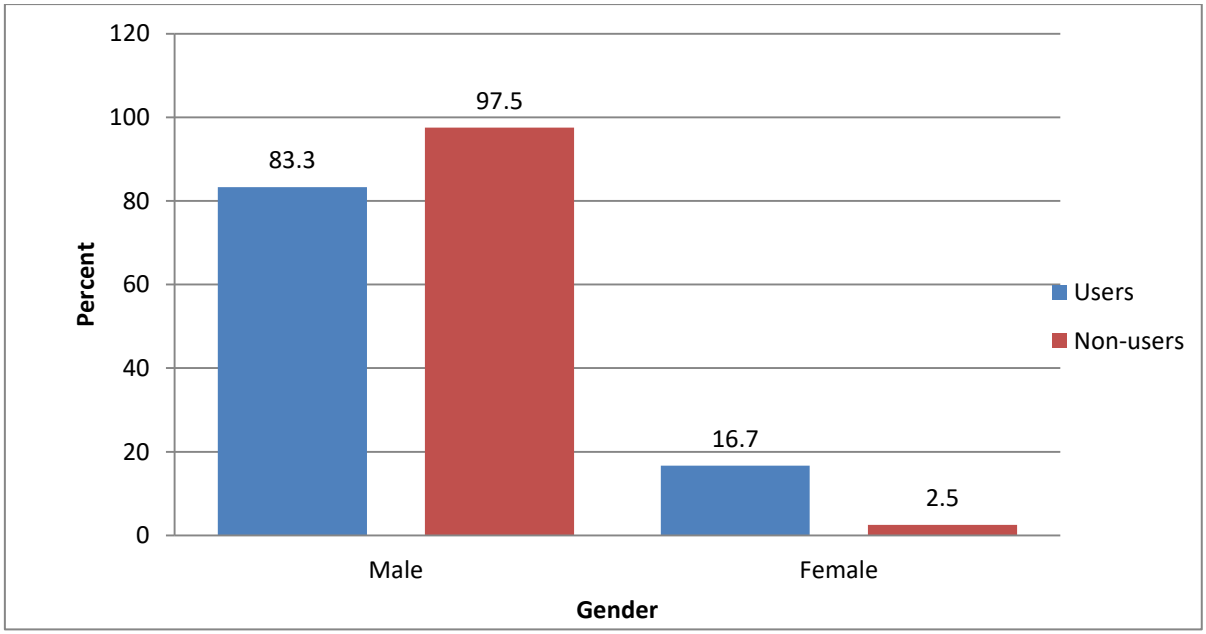

Figure 4.1: Information sharing system user groups by gender

From the results, 91.4% of the surveyed farmers indicated that they depended on agriculture as their main source of income, compared with only 6% who reported that they did not depend on agriculture as their main source of income. Similar findings by Mwiinga (2009) indicated that tomato production and sales highly affect the purchasing power of agricultural households. The high percentage of farmers who reported being dependent on agriculture as their main source of income indicates the importance of agriculture to these tomato farmers.

It was also found that 50% of the respondents reported that they grew only tomatoes during the survey period. The other 50% reported that they grew several other fresh vegetables that they also traded on the Soweto market. The other vegetables grown include Chinese

cabbage, cabbage, cucumbers, rape, onion, eggplants, green pepper, green beans and pumpkin leaves.

When it comes to the highest levels of education attained by the farmers, 34.3% had attained primary education, 44.3% had gone to secondary school, while 24% had attained tertiary education. This translates to 15 out of the total of 70 farmers who had attained tertiary education. Further, of the 15 farmers that attained tertiary education, only 5 stated that they had their tertiary academic training in agriculture. Therefore, overall, only 7% of all the farmers surveyed had received academic tertiary training in agriculture. The lack of tertiary education among farmers has the potential to negatively affect the advancement of such farmers to more sophisticated and more profitable formal tomato channel systems. Tertiary education equips farmers/traders with the knowledge and entrepreneurial skills required to cope with the stringent quality requirements and efficiency levels that are demanded by such systems. As such, formal tomato market channels are more favourable to those that have attained a reasonably higher level of education. Farmers who are more educated might also have better access to information, and ultimately better negotiation/bargaining power.

4.3 The relationship between tomato farmers and brokers

In order to gain a more vivid picture of the types of relationship that exist between tomato farmers and brokers, from the farmers' perspective, the survey requested all of the 70 farmers under study to answer certain questions regarding their relationship with the brokers. Firstly, farmers were requested to describe their level of satisfaction with the services provided by the broker they use. According to the results presented in Figure 4.2 below, 60% of the users and 62.5% of the non-users of the information sharing system were satisfied with the service of their brokers, 20% of the users and 5% of the non-users were very satisfied, and 16.7% of the users and 32.5% of the non-users were unsure. None of the farmers indicated that they are very dissatisfied with the brokerage services, and only 3.3% of the users reported that they were dissatisfied. This reflects a positive picture of the level of satisfaction with broker services among farmers because the majority of the farmers under the survey were at least satisfied with the brokerage services that they were receiving from their broker.

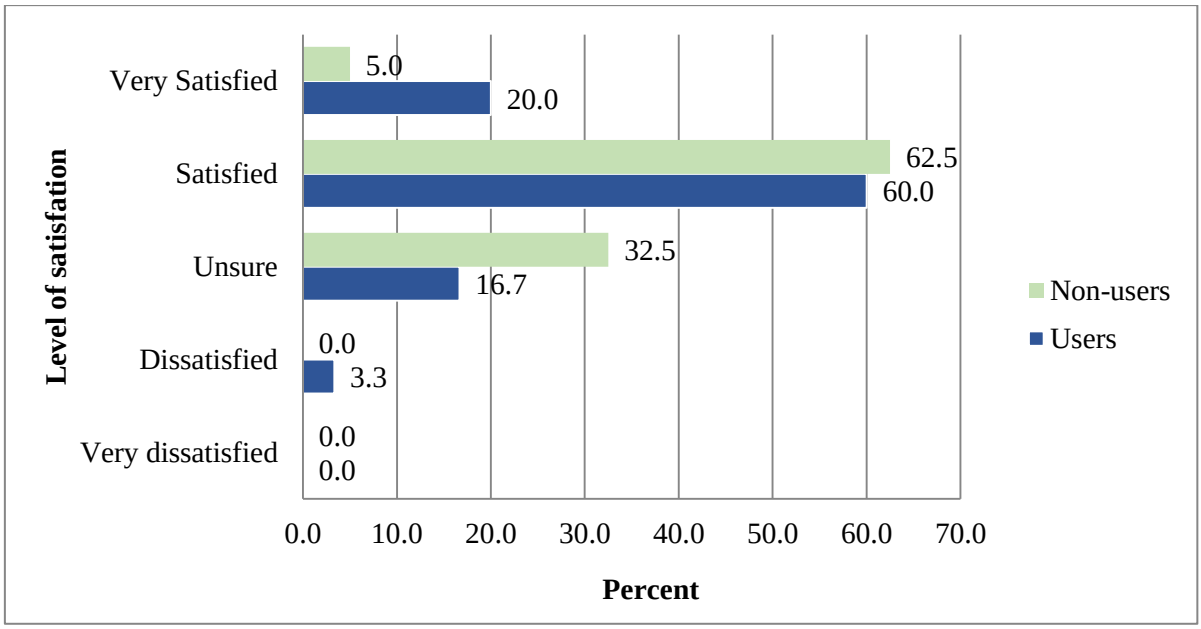

Figure 4.2: The levels of farmer satisfaction with broker services

The farmers were further asked whether they thought that their broker was honest about commission and sales. It can be seen from Figure 4.3 below that the users of the information sharing system were equally split (50%) between 'yes' and 'no' in terms of commission. In terms of sales, 60% said 'yes', while 40% said 'no'. Moving on to the non-users' responses to being asked whether they thought that their broker was honest when it comes to the commission, 15% said 'yes', 17.5% said 'no', while 67% were 'not sure'. For sales, 12.5% of the non-users said 'yes', 12.5% said 'no', while 5% were 'not sure'.

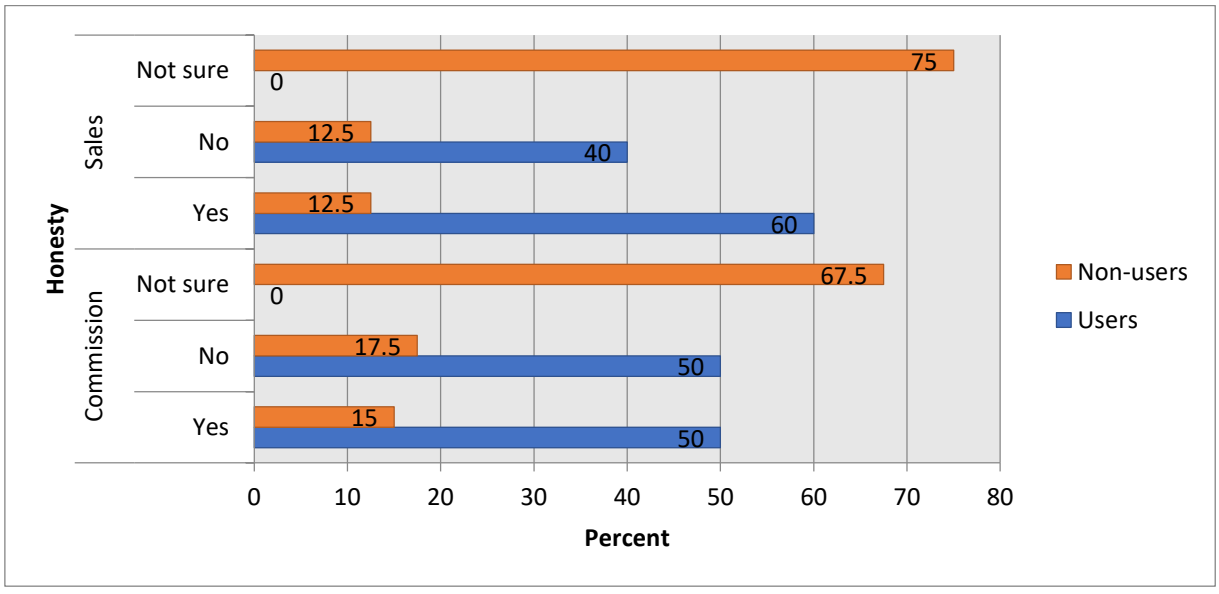

Figure 4.3: Farmers' perceptions of broker honesty about commission and sales

What stands out from these results is that the majority of the non-users of the information sharing system were unsure in both cases. In response to the commission and sales questions, no users of the information sharing system reported that they were not sure of their broker's honesty in terms of sales or commission. This could be because having access to price information by users of the information sharing system allowed them to be more certain about whether their broker was honest or not.

The farmers were further asked whether they have had any conflict about commission with their broker. It can be seen in Table 4.2 below that only 15 out of all the 70 sampled farmers reported having had conflicts about broker commission with their brokers.

Table 4.2: Farmer–broker conflict about broker commission

Farmer type	Have you ever had any conflict about commission with your broker?		Total
	Yes	No	
User	7	23	**30**
Non-user	8	32	**40**
Total	**15**	**55**	**70**

In addition, the users of the information sharing system were asked if they had had conflicts about commission with their brokers since they had started using the system. Similar to the case above, Table 4.3 below shows that very few users (five) reported having had conflicts with their broker, compared with 25 who reported that they had had no conflict with their brokers since they had started using the information sharing system.

Table 4.3: Farmer–broker conflict about broker commission after using the system

Farmer type	Have you ever had any conflict about commission with your broker since you started using the information sharing system?		Total
	Yes	No	
User	**5**	**25**	**30**

4.4 Farmers' perceptions of the information sharing system

Another aspect that was considered in this particular study was obtaining more information about the effects of the use of the information sharing system on the hidden commission, from the farmers' perspective. In this regard, the users of the information sharing system

were asked a few questions to obtain this information. Firstly, the farmers were asked when and why they had started using the information sharing system in the Soweto market. They were then asked whether they thought the use of the system reduced the hidden commission charged by the brokers.

The results indicated that the farmers had been using the information sharing system for an average of 2.5 years (as at July, 2017). When it comes to the reason why they had started using the information sharing system, three main reasons were provided by the users, as shown in Table 4.3 below. Table 4.4 shows that 50% of the users started using the system because they had been approached by the implementers, while 16.7% reported that other users had recommended the use of the system. Only 10% reported that they had been searching for a source of price information because they had suspected that their brokers were very dishonest.

Table 4.4: Reasons for using the information sharing system

Response	Frequency	Percent
Searching for price information	10	33.3
Approached by the implementers	15	50.0
Other users recommended	5	16.7
Total	**30**	**100**

However, when users were asked if other farmers had come to them to ask about the information sharing system, only 2 out of the 30 users (6%) said that they had experienced this. In both cases, communication about how the system works was done face-to-face. These two farmers reported that they shared information about how the system works because they had noticed an increase of their bargaining power in their transactions. They also noticed that it now took less time to sell their tomatoes on the market since they had informed their broker that they used the information sharing system.

A Likert scale question was posed to the 70 surveyed farmers to ask whether they thought that the use of the system reduced the hidden commission charged by brokers. As presented in Table 4.5, 16 farmers reported that they thought the use of the system slightly reduced the hidden commission, while 7 were of the view that the hidden commission was not reduced at all. Only one user of the system was of the view that the use of the system led to an extremely large reduction of the hidden commission. It can be seen from Table 4.5 that the majority of the users of the system had a positive perception of the effect of the

system on hidden commission. This was reflected by the users who were of the view that the use of the information sharing system reduced the hidden commission (to either a low or high degree). This includes those who responded that the hidden commission was 'slightly', 'somewhat', 'moderately' or 'extremely' reduced. The total number of responses received in this group was 23, which represents 76.7% of the farmers using the system under survey for this study. Similarly, the negative responses were reflected by the users that were of the view that the hidden commission was not reduced at all. Only 7 farmers gave this response, which represents only 23.4% of the users of the system surveyed under this study.

Table 4.5: Farmers' perceptions of change in hidden commission due to the information sharing system

Response	Frequency	Percent
Not at all	7	23.3
Slightly reduced	16	53.3
Somewhat reduced	2	6.7
Moderately reduced	4	13.3
Extremely reduced	1	3.3
Total	**30**	**100**

So far, the information provided in this section has focused on tomato production and marketing in Zambia, including the details of farmer and broker transactions. Additionally, information on the characteristics of the respondents under the current study and the information sharing system has been provided. The results indicate that the users of the information sharing system generally had a positive perception regarding its effect on reducing opportunistic behaviour. However, a quantitative analysis to test for broker opportunistic behaviour is required to make further inferences.

4.5 Transaction engagements between tomato farmers and brokers

The other objective of this study was to determine the perceptions of the users and the non-users of the information sharing system about the tomato brokerage system on the Soweto market. An important aspect of the brokerage system is the competitiveness among brokers because it explains the behaviour of brokers towards other market players and the market environment in which they operate. For example, brokers may not behave competitively by hindering the flow of information on supply and demand or on the commissions they are

charging. Understanding the perception of the users and the non-users of the information sharing system provides a better understanding of the performance of brokers and therefore shapes perceptions about opportunism. Porter's model has been used to conduct the analysis because it enables the analysis of the key elements of competitiveness, in any industry.

The results that are presented and discussed here were mainly obtained from the FGDs. However, some supporting results obtained from the face-to-face individual interviews have been added to complement some of the FGD results. The FGDs were conducted using the interview guide (see Appendix B, page 107) from the FGDs, and the reported experiences attitudes and thoughts of FGDs participants were categorised into two broad themes, broker competitiveness and the renegotiation process. This section has, therefore, analysed the farmer–broker transaction from these vantage points.

4.5.1 Competitiveness on the Soweto market

Porter's Five Forces Model (Porter's model) was used to assess competitiveness on the Soweto market, specifically between tomato farmers and brokers. Porter's model was developed as a tool to assist in assessing the nature of an industry's competitiveness (Porter & Millar, 1985). The five main competitive forces identified through this model are the threat of new entrants, the threat of substitute products or services, the bargaining power of buyers, the bargaining power of suppliers, and competitive rivalry among existing firms (Ndanga et al., 2015).

The Five Forces Model is typically used as a framework to analyse the level of competitiveness of particular companies, a market segment, industries, or regions. A few studies in the agriculture sector have used the Five Forces Model as a framework for analysis. Ndanga et al. (2015) used it to analyse the competitiveness in the aquaculture industry in Kenya, while Rachapila and Jansirisak (2013) used it to examine the competitiveness in the Thai sweetcorn industry. Similarly, the Five Forces Model was used to examine the competitiveness among tomato brokers on the Soweto market.

Based on the information that was given by the FGD participants, the forces were rated as strong, moderate or weak. While strong forces are those that have a large effect on broker

competitiveness, the weak forces are those that barely affect the competitiveness of tomato brokers on the Soweto market.

Competitive rivalry among brokers

The competitive rivalry force aspect looks at whether there is strong rivalry among the brokers, and whether there is a single dominant player. In the context of the current study, the competitive rivalry force is a moderate force. Firstly, the FGD participants indicated that there are relatively fewer brokers on the Soweto market than there are traders. The broker-to-farmer ratio is about 1:5. Furthermore, the participants mentioned that they have observed that the number of brokers on the Soweto market has not changed much over the years because new brokers rarely join the market.

Nearly all the users and non-users of the information sharing system reported having observed a lack of rivalrous behaviour among brokers on the market. It was stated that no strong rivalry was observed where brokers were seen to compete intensively for clients. They further explained that brokers rarely fight for clients because clients are often introduced to the brokers prior to the transactions on the market. One participant was cited, saying:

> "… *If you are a new farmer and you do not have a broker at the market, you have to contact one of the farmers that have been trading on the market to introduce you to a broker to assist you upon arrival at the market ....*"

New clients for the brokers are often obtained through existing clients. For one to trade on the Soweto market as a fresh-produce seller, another seller who already has experience on the market has to introduce the new member to a broker (usually his/her broker). This leaves very little room for brokers to engage intensively in competing for clients with other brokers.

Threat of substitution or switching brokers

This threat is a strong force because there are several brokers on the Soweto market, and farmers can move easily from one broker to another, as they wish, because there are no switching costs to deal with. However, the participants went on to elaborate that

they do not regularly switch brokers unless there are irreconcilable differences between a farmer and a broker. This can also explain the results obtained in the face-to-face interviews when the farmers were asked if they had ever switched brokers. The results are presented in Table 4.6 below. It can be seen from the table that very few farmers among the users and the non-users of the information sharing system switched brokers. Only 2 users and 7 non-users reported having previously switched brokers.

Table 4.6: Broker switching by tomato farmers

Farmer type	Have you ever switched brokers?		Total
	Yes	No	
User	2	28	**30**
Non-user	7	33	**40**
Total	**9**	**61**	**70**

Those respondents who reported having switched brokers at least once were requested to answer a follow-up question to provide a reason for deciding to switch brokers. All the 9 farmers reported that they had switched brokers because they had realised that their tomato sales were very slow compared with other farmers, even though their tomatoes were clearly of better quality than the others were. The high number of non-users who switched might have been more inclined to switch since they are not 100% sure of their broker's honesty when pricing products. The fact is that a farmer has no means to verify the prices that the broker reports, and brokers can be more opportunistic.

When the switching of brokers was discussed in the FGDs, it was explained that those farmers who had decided to switch brokers were often convinced to do so by other farmers who claimed to have a better broker. A farmer who had recently switched brokers was cited, saying:

> *"... I switched brokers because I could tell that my broker was inflating the price of my tomatoes. Other tomato farmers were getting their tomatoes sold quickly while my tomatoes were on the market for too long, and yet mine were of better quality compared to the others. I talked to my neighbour, a fellow tomato farmer, and he introduced me to his broker ...."*

Threat of new brokers entering the market

This threat is a weak force because it is very difficult for new brokers to start to compete with the already established brokers on the market, especially since farmers and traders entering the market are introduced to brokers by fellow farmers. The brokerage business does not require special skills or knowledge, and the financial and non-financial costs of entry are low because there are no capital requirements. However, what keeps competition away is the point that one has to have detailed knowledge of the market operations and build acceptance among the clients and the other brokers in order to participate in the market. This can only be done over a long period of time. In fact, the FGD participants all emphasise that one has to be "well connected" to enter the business. One FGD participant, who has attempted to join the business, shared his experience, saying:

> "*I failed to make it in that business because I had no clients to serve. The only people that make it are those that are close to one of the brokers such as their relatives. Entering the business is done in several stages. The broker has to first work with you by sending you around as a form of orientation. Eventually, you will start getting to know the clients because he will introduce you to them as you are working together. You become his assistant until you can work on your own."*

Bargaining power of farmers

This force involves the bargaining power exerted by the suppliers of inputs that are used to operate the brokerage business. The force is moderate because farmers (as suppliers of the tomatoes) do not have much control over the conditions under which they supply the inputs, but they contribute to building the reputation of the brokers whom they use. On the one hand, farmers do not have much of a choice in terms of whether to use a broker or not, as they are all coerced to use brokers to conduct sales on the Soweto market. The FGD participants explained that this is due to the weak enforcement of the rules and regulations that guide transactions on the Soweto market, which forbid the use of force among market players. The general view was that the legal system at the Soweto market is "non-functional". They explained that there is a lack of recognition among the Soweto market

actors of the current rules and regulations of market operations, and there is no credible enforcement mechanism.

On the other hand, brokers have an incentive to transact fairly with each tomato farmer in order to gain a good reputation because they acquire new clients (tomato farmers) through recommendations from their current clients. The ability to be able to recommend brokers to other farmers gives the tomato farmers some power. However, their lack of access to market and price information reduces the power they have because they are unable to determine the degree of honesty of the brokers. They only suspect that their broker may be dishonest when sales are slow, but they are often unable to provide evidence of this.

Although all the tomato farmers are forced to use brokers on the market, the participants explained that they often have room to negotiate the broker commission with the brokers. Sometimes, farmers can negotiate to pay brokers a commission of less than 10%, and brokers agree. This usually occurs when a farmer has very small quantities of tomatoes on the market, meaning that the total amount of money they earn from their sales is equally small.

Bargaining power of traders

The barging power of traders is also a strong force because brokers compete for buyers, even though there are several traders on the market. This is more so for buyers who often purchase relatively larger volumes of tomatoes than other traders do.

4.5.2 Price renegotiation process

Opportunistic behaviour by brokers extends somewhat to the price renegotiation process that occurs when sales are slow and tomato price adjustments are required. The FGD participants, especially the non-users of the information sharing system, indicated that the arguments they often have with their brokers are about sales. This is also indicated by the results obtained from the face-to-face individual interviews when the 70 farmers were asked if they have had conflicts with their brokers regarding tomato sales. The results obtained from the face-to-face individual interviews are presented in Table 4.7 below. It can be seen that 48 out of the 70 farmers interviewed indicated having had conflicts about

sales. The FGD participants explained that these conflicts occur when tomatoes remain on the market for too long. This engenders suspicion from farmers. They suspect that the brokers are not expending the effort required to sell their tomatoes, or that they inflated the price too high for available buyers to buy.

Table 4.7: Framer–broker conflict about sales

Farmer type	Have you ever had any conflict about sales with your broker?		Total
	Yes	No	
User	18	12	**30**
Non-user	30	10	**40**
Total	**48**	**22**	**70**

However, the users of the system acknowledged that there was an improvement regarding the issues of slow sales after they started using the system. This information was equally obtained from the face-to-face individual interviews when farmers were asked if they had had any conflicts with their brokers since they had started using the information sharing system. Only four of the users of the information sharing system reported that they had conflicts about sales with their broker since they had started using it, while 26 users responded that they had not had conflicts. This might be attributed to the fact that farmers had informed their brokers that they were actively using the information sharing system.

In order to understand the severity of the renegotiation process among the tomato farmers, both the users and non-users were then requested to provide information on how often brokers requested a renegotiation of tomato prices due to slow sales. The results presented in Table 4.8 below show that 36.7% reported that they were rarely contacted for price renegotiation, 56.6% reported that they were contacted sometimes, and 6% reported not being contacted at all. As for the non-users, 36.7% reported that they often are contacted for price renegotiation, and 25% reported that they always are contacted. This indicates that the majority of the non-users were contacted to renegotiate tomato prices more frequently than the users were.

Table 4.8: Frequency of renegotiation requests from brokers

Farmer type	How often in one transaction does the broker contact you to renegotiate the price?					Total
	Never	Rarely	Sometimes	Often	Always	
Users (%)	6.7	36.7	56.6	0	0	**100**
Non-user (%)	2.5	15	20	37.5	25	**100**

During the FGDs with the users, they expressed concern over the price renegotiation process in instances when they had to renegotiate tomato prices with brokers. They explained that the renegotiation process is very difficult, as they usually have to agree with the price suggested by the broker. The reason provided revolved around the poor physical infrastructure of the market, as this worsens the bargaining position of the farmers, which is a point highlighted by other studies (Mwiinga, 2009; Hichaambwa & Tschirley, 2010). The Soweto market is simply an open space without a roof or proper storage space for fresh produce, as shown in Figure 4.4 below. This means that farmers do not have proper storage space and cannot control the storage environment for their highly perishable produce. They further elaborated that the end result of all this is that farmers usually have no choice but to agree to relatively low prices with the broker, for the fear of selling their produce at an even lower price the next day if they allowed their produce to stay overnight.

Figure 4.4: The Soweto market in Lusaka, Zambia

Source: own pictures

Therefore, even with the use of the information sharing system, the users explained that the information obtained from the information sharing system could not be used during the re-negotiation process. The negotiation process is solely based on the perishable nature of the produce, and on the farmers' urgent need to sell the tomatoes as quickly as possible. This implies that the increase in farmers' bargaining power engendered by the use of the information sharing system is eroded by the poor infrastructure of the Soweto market. Ultimately, this has a negative effect on their profits.

4.6 Testing for opportunistic behaviour

Opportunistic behaviour, in the context of the current study, is the behaviour exhibited by Zambian tomato brokers of proving false tomato price information to tomato farmers whom they provide brokerage services to. The broker and farmer initially agree on a broker commission of about 10% of the total amount sold. However, brokers tend to inflate the price when conducting sales to retailers. They do this in order to pocket the difference between what they agreed on with the farmer and what they actually sold the tomatoes for. The money that is not declared to the farmer is the hidden commission.

This hidden commission was used as a proxy for opportunistic behaviour in this study. The test for opportunistic behaviour was conducted in two steps. The first step of this process was to compute the hidden commission, represented by the difference between the mean first seller price and the mean wholesale price. The next step was to determine the statistical significance of this mean hidden commission. This was done by conducting a t-test to compare the mean first seller price and the mean wholesale to determine if the difference was statistically significant. This analysis was carried out on the group of users of the information sharing system, and this was then repeated on the group of non-users. A statistically significant hidden commission indicates the presence of opportunistic behaviour, while the opposite indicates the absence of opportunistic behaviour.

4.6.1 Tomato prices and hidden commissions

Information about tomato prices in the Soweto market in Zambia for the three groups of farmers is presented in Table 4.9. The table specifically presents price information for the

two groups of interest for this study – the users and non-users of the information sharing system. Also included is the price information for the users of the Soweto market in 2010, retrieved from Hichaambwa and Tschirley's (2010) study, which was conducted before the information sharing system was introduced. By "first seller price", we refer to the price that the farmer and the broker agreed to for the broker to sell the tomatoes at, while the "wholesale price" is the actual price at which the broker sells the tomatoes. The "hidden commission" is the difference between the first seller price and the wholesale price; this is the amount that the broker adds to the first seller price without getting the farmer's consent.

Table 4.9: Tomato prices and broker commission in the Soweto Market (Lusaka).

	Information sharing system 2010[16] group	**Information sharing system users (2017)**	**Information sharing system non-user 2017**
Mean first seller price - USD/kg (A)	0.271	0.331	0.340
Mean wholesale price - USD/kg (B)	0.302	0.352	0.390
Mean transparent commission - USD/kg (C)	0.028	0.030	0.031
Mean hidden commission - USD/kg (D)=(B-A)	0.032	0.018	0.049
Total commission - USD/kg (E)=(C+D)	0.059	0.049	0.082
Total commission as % of wholesale price (F)= (E/B)	19.54	13.96	20.89
Mean transparent commission as % of wholesale (G)=(C/B)	9.10	8.59	8.13
Mean hidden commission as % of wholesale price (H) = (F- G)	10.44	5.37	12.77

Note: Exchange rate, 1USD = 10 ZMW

The farmer and the broker agree on a commission for brokerage services, which is referred to as the "transparent commission". The official transparent commission is about 10% of

16 All prices in ZMK (old Zambian currency) were converted to ZMW (new Zambian currency) by diving the ZMK value by 1000, since 1000 ZMK= 1 ZMW. The 2010 prices were further adjusted for inflation using the consumer price index (CPI). This was then converted to USD by using 1USD = 10 ZMW.

the total amount of tomato sales, although it may be slightly higher for very large quantities of tomatoes, or lower for very small quantities. The “total commission” is defined as the sum of the transparent commission and the hidden commission. The commissions are expressed as percentages of the wholesale price, as presented in Table 4.8 above.

Without any opportunistic behaviour, the first seller price and the wholesale price would be expected to be the same; this consequently eliminates the hidden commission from the transaction. In such a case, the transparent commission is equal to the total commission. Therefore, while the transparent commission is part of every transaction in this context, the hidden commission would only be present if the broker had added an additional amount to the price at which the farmers agreed for their tomatoes to be sold. However, the results presented in Table 4.8 above indicate that, in all the three groups, there was a difference between the mean first seller price and the mean wholesale price.

While the mean hidden commission added by brokers for the tomato farmers surveyed in 2010 was 10.4% of the wholesale price, the users of the system had brokers adding a 5.37% mean hidden commission, and the 2017 non-users of the system, a 12.8% mean hidden commission. This translated into a total commission of 19.5% for the 2010 group (before the information sharing system was introduced), 14% for the current users of the system, and 20.9% for the 2017 non-users. While this difference was not the same across the groups, all three cases indicated the presence of hidden commission. This implies that in all the three cases, brokers charged a higher price on the wholesale market than the price agreed with the farmer (the first seller price).

When it comes to the total commission, this is supposed to be fixed at 10% of the total amount sold for each transaction. However, it can be seen in Table 4.8 above that each group of farmers was found to be charged a total greater than 10% commission by the brokers. The users of the information sharing system were charged a total commission of 13.96%, the 2010 group 19.54%, and the 2017 non-users were charged the highest total commission of 20.89%. This indicates that, apart from the users of the information sharing system, the other two groups of tomato farmers were charged about twice the normal commission.

The groups of users of the information sharing system experienced a lower mean hidden commission than the two groups that did not use the information sharing system, which may be explained by the use of the information sharing system by this group. Having access to price information means that the users would be able to check tomato wholesale prices at any point during the day and would be able to compare these prices with the prices which they agreed on with their brokers. Any difference between the two prices would indicate to the farmer that the broker had inflated the price. From the outset, farmers informed their brokers that they had access to this information, which indicates that the brokers knew that the tomato farmers had access to the information sharing system. As such, brokers ensured that the price they sold the tomatoes belonging to these farmers was as close as possible to the price that they had agreed with the farmers. This is because a large difference between the two prices would become apparent to the tomato farmers, and this would be hard evidence of dishonesty by the broker, and would probably affect the reputation of the broker, with the result that farmers would distrust them and they might lose business.

The presence of a small hidden commission, such as the mean hidden commission of 5.37% in Figure 4.5 for the users of the system, may be attributed to the nature of the operations of the information sharing system. The price that is reflected in the information sharing system is an average of the prices entered by several brokers in the specific markets. Therefore, it may have slightly differed from the selling price for each individual farmer's tomatoes. This means that a user may have noticed a slight difference between the price at which the broker sold their tomatoes and the price in the information sharing system at any point. The broker might get away with such small differences because the information sharing system shows average tomato prices for each market at any given point.

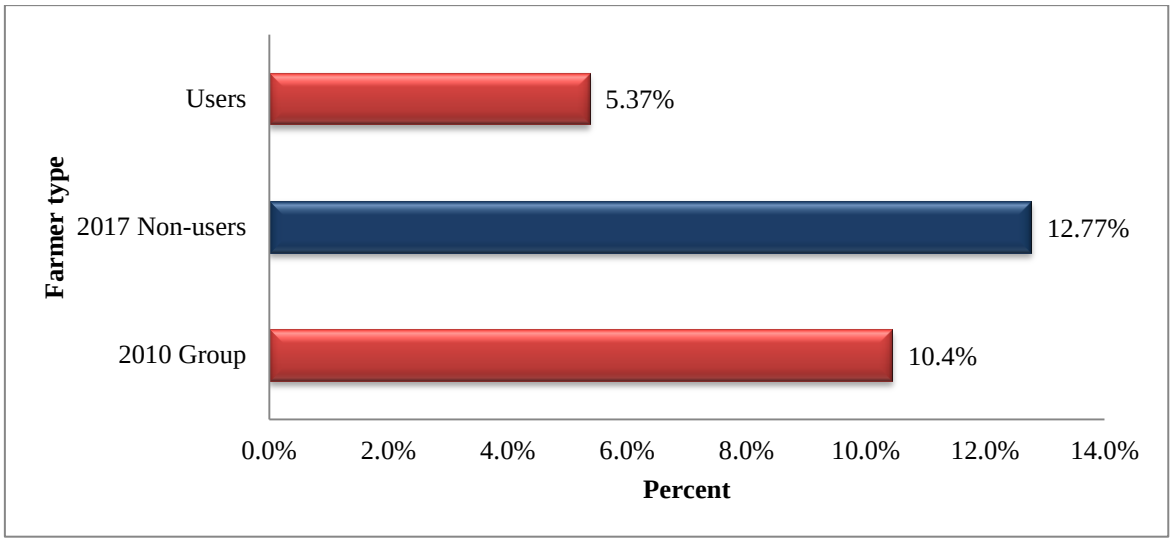

Figure 4.5: Mean hidden commission as a percentage of the wholesale price

In addition, the difference between the hidden commission for the 2010 group and the 2017 non-users of the information sharing system is further highlighted in Figure 4.5 above. The mean hidden commission, as a percentage of the wholesale price, increased from 10.4% for the 2010 group to 12.77% for the non-users of the information sharing system. As for the users, it reduced to 5.37% from the initial 10.4% in 2010. Given that the brokers deal with both users and non-users, it could be that the brokers realised that they were losing out in terms of hidden commission for the users of the system. In light of this, it makes sense that the brokers considered increasing the hidden commission when dealing with the non-users of the information sharing system in order to offset the loss in hidden commission extracted from the users of the system.

As for the non-users of the system, they relied on the brokers to give them all the price information in the Soweto market. This means that any inflation of the price agreed on between the brokers and the farmers would go unnoticed by the farmers because they did not have any way of checking the actual tomato prices (wholesale price) used by the brokers to sell their produce.

4.6.2 Are brokers opportunistic?

The mean hidden commission computed was used as a proxy for opportunistic behaviour. As mentioned in the previous section, the numerical difference between the mean first seller price and the mean wholesale price indicates the hidden commission. In this case,

both the user and non-user transactions were found to have hidden commissions. The hidden commission for the users of the information sharing system was 0.082 USD/kg, while that for the non-users was 0.049 USD/kg (see Table 4.8 above). However, it is important to determine if these hidden commissions (the price differences) are statistically significant.

To test for significance, an independent samples 2-tailed t-test was conducted on each of the results of the two groups. A statistically significant hidden commission would indicate the presence of opportunistic behaviour, while the opposite would indicate the absence of opportunistic behaviour. The t-tests were conducted on the hidden commissions of the two groups in order to not only determine whether broker opportunistic behaviour still exists among users, but also to determine how this compares to opportunistic behaviour in transactions with non-users of the information sharing system.

Users of the information sharing system (with n=30)

The following hypothesis was tested:

Null hypothesis:	The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who use the mobile phone based information sharing system.
Alternative hypothesis:	The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are not equal for the farmers who use the mobile phone based information sharing system.
t-test statistic:	-1.821
p-value:	0.076
Rejection rule (p-value >0.05):	At a 5% level of significance, we fail to reject the null hypothesis that the mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who use the mobile phone based information sharing system.

It can be concluded that the mean first seller price and the mean wholesale price negotiated by brokers is equal for the farmers who use the mobile phone-based information sharing system, and is not statistically significant at a 5% level of significance. As expected, the results suggest that when tomato farmers use the information sharing system, the hidden commission charged by brokers reduces. This could be because brokers do not inflate the tomato prices agreed on with the farmers who use the information sharing system. If they were to inflate the tomato prices, then the farmers would find out, as they have access to price information via the information sharing system.

The results for the users of the system reveal that the hidden commission for the users of the information sharing system is not statistically significant. This is because the mean first seller price is not statistically different from the wholesale price. This implies that tomato farmers who had access to price information through the information sharing system were exposed to very little, to no, opportunistic behaviour by the brokers. The tomato prices that users of the system agreed on with the broker were not significantly inflated by the brokers in an effort to increase their commission from tomato sales.

Non-users of the information sharing system (with n=40)

The 2-tailed independence t-test was repeated for the non-users of the information sharing system. Similarly, the following hypothesis was tested:

Null hypothesis:	The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who do not use the mobile phone based information sharing system.
Alternative hypothesis:	The mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are not equal for the farmers who do not use the mobile phone based information sharing system.
t-test statistic:	-3.566
p-value:	0.001
Rejection rule (p-value< 0.05):	At a 5% level of significance, we reject the null hypothesis that the mean first seller price and the mean

wholesale price negotiated by brokers are equal for the farmers who do not use the mobile phone based information sharing system.

It can be concluded that the mean first seller price and the mean wholesale price negotiated by brokers is equal for the farmers who do not use the mobile phone-based information sharing system.

However, the t-test conducted on the comparison group, which comprises the non-users of the system, reveals different results from those of system users. The hidden commission for farmers who did not have access to tomato price information through the information sharing system is statistically significant. This suggests that transactions that involved the group of farmers who did not have access to tomato price information through the information sharing system are characterised by opportunistic behaviour, as brokers inflated tomato prices by a significant amount. These results indicate the usefulness and the effect that the information sharing system has in reducing opportunistic behaviour by market brokers through making increased access to information available.

4.6.3 Information sharing systems to reduce opportunistic behaviour

The findings of the current study can also be explained in terms of information asymmetry between the tomato brokers and farmers. This is because the opportunistic behaviour under consideration is centred on brokers having more market information than farmers do, and using it to earn more commission than they declare. This is underscored by the results which indicate that the users of the information sharing system were charged a hidden commission of 5.37%, while the non-users who were charged a hidden commission of 12%. Furthermore, the 5.37% hidden commission was found to be statistically insignificant, while the hidden commission of 12% was found to be statistically significant. As such, the results of the current study indicate a reduction in information asymmetry that may be attributable to the use of the information sharing system. The results of the current study corroborate those of De Silva et al. (2008) who assert that information asymmetry challenges can be reduced by the use of the most basic mobile phones. In addition, from a broader economic perspective, Madden and Savage (1998) found that the flow of

information is key to achieving effective functioning of markets; therefore, the access to information contributes positively to economic development.

The results of other studies, with similar findings to the current study, were reported in terms of the use of information sharing systems to improve the bargaining power of farmers (Myhr, 2006; Svensson & Yanagizawa, 2009; Courtois and Subervie, 2014). Often, differences in bargaining power attributable to information asymmetry between two transacting parties results in opportunistic behaviour by the party with more information. Myhr (2006), Svensson and Yanagizawa (2009), and Courtois and Subervie (2014) describe situations that involve farmers having very little bargaining power in their transactions with traders or middlemen who have unilateral access to price information. The studies found that the use of information sharing system then contributed to enhancing farmers' bargaining power. Access to price information prevented the other party from reporting false price information to the farmers in order to get a better deal. This is essentially the same as using information sharing systems to deter opportunistic behaviour because information asymmetry reduces bargaining power and increases exploitation.

It comes as no surprise that this study found that the use of the information sharing system to reduce information asymmetries was associated with a reduction in brokers' hidden commission, as such results are in line with other similar studies. There are a number of studies that have found that information sharing, or farmers' gaining access to agricultural market/price information, has an effect of reducing opportunistic behaviour in transactions that involve farmers. Similar results were reported by Asheeta et al. (2008) about the use of a mobile phone helpline, called the Palliathya initiative, in Bangladesh to provide market information, including price information, to farmers. It was found that the use of the Palliathya initiative resulted in reduced information gaps and the prevention of the exploitation of farmers. In addition, Van der Merwe et al. (2017) found that information sharing among farmers (in farmer networks) in South Africa and with abattoirs resulted in a reduction of farmers' opportunistic behaviour.

4.7 Information sharing and Information spillovers

Having tested for opportunistic behaviour in the previous section, this section determines if there were information spillovers of the mobile phone information system to non-user

tomato farmers, and identifies the main information needs and important information sources used by the tomato farmers. Also presented in this section are the agricultural market information needs of the farmers that were identified through responses received during the individual interviews.

4.7.1 Indications of information spillovers

The first objective mentioned above is addressed by using the results from Table 4.8 in the previous section and other data collected using the questionnaire, with the purpose of determining whether the non-users possibly benefited from the information or benefits acquired by the users of the system.

With regard to identifying information spillovers, the main interest was to determine the diffusion of the innovation (the information sharing system) in question. The logic here is that information about the information sharing system, if known and indirectly used by the non-users, should be able to have a similar effect on hidden commission as the effect it had on users. This means that if the mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who use the mobile phone-based information sharing system, a similar result is expected for non-users, and this would indicate the presence of diffusion of information about the information sharing system. In addition, a question was included in the survey questionnaire for non-users of the system to elicit information indicating the familiarity of the non-users with the information sharing system. This would also indicate a diffusion of information about the information sharing system among the farmers.

Similar to Foster and Rosenzweig (1995), the assumption used for the analysis in this section is that if there were information spillovers regarding the system from the users to the non-users, the non-users would then use the information in the same way that the users do. As an indirect effect of the information sharing system on the non-users, it was expected that the hidden commission for the non-users would, to some extent, be reduced, as is the case with the users of the system. In this regard, Figures 4.6 and 4.7 below compare the mean hidden commissions of the users and non-users of the information sharing system, using computations from Table 4.8 above.

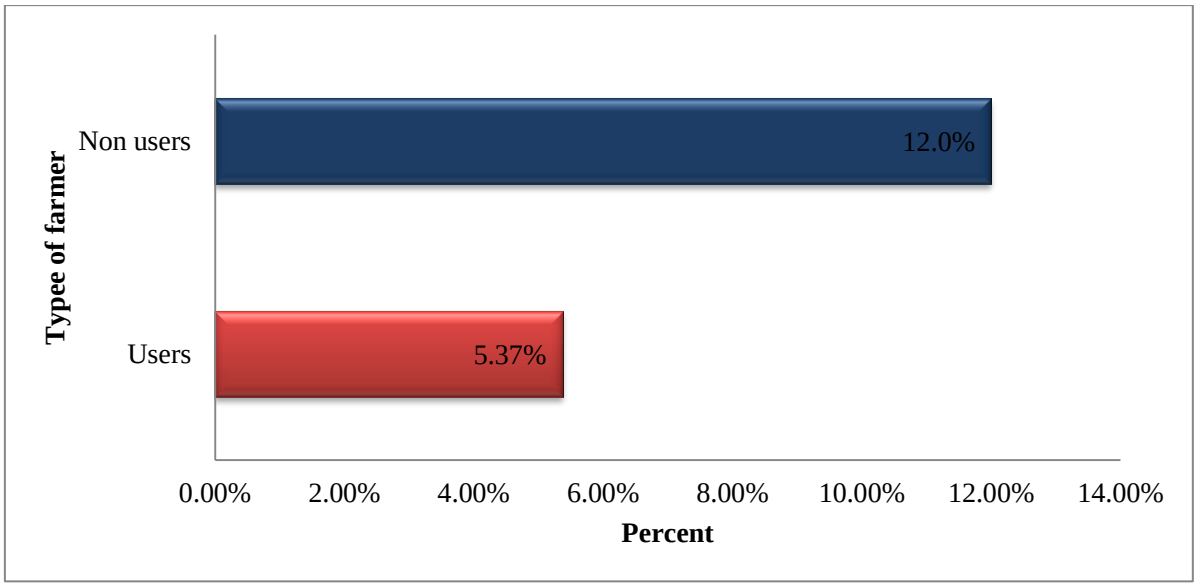

Figure 4.6: Mean hidden commission as a percentage of the wholesale price for users and non-users

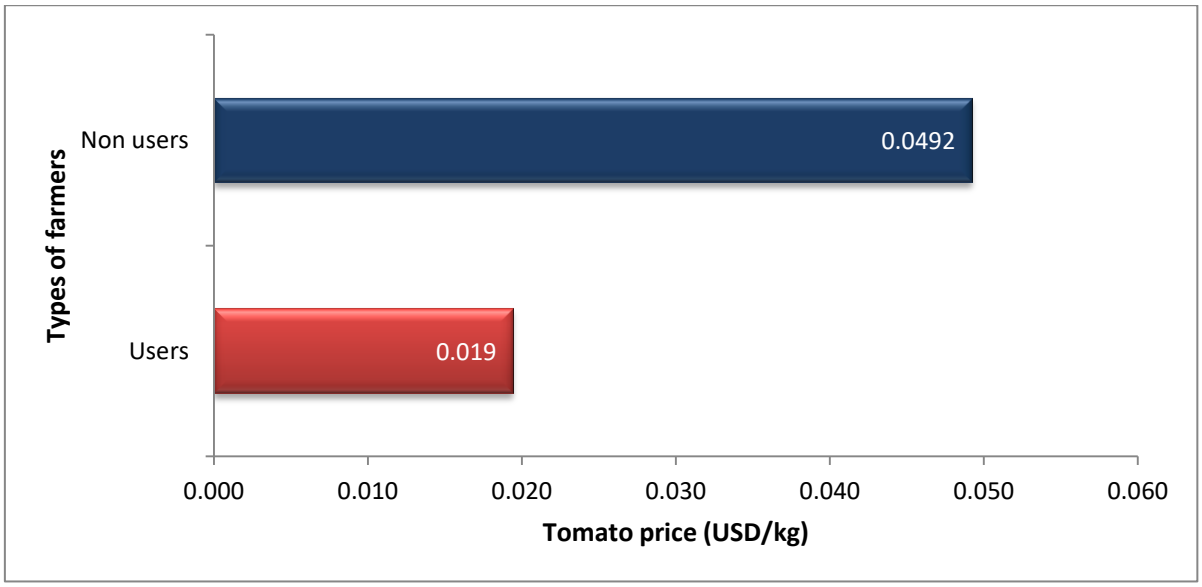

Figure 4.7: Mean hidden commission in USD/kg for users and non-users

It is apparent that the mean hidden commission for the users, 0.0194 USD/kg, is much lower than that for the non-users is (0.0495 USD/kg). This translates to 5.37% and 12% hidden commissions for the users and non-users, respectively. Considering that the hidden commission in 2010 was 10.4%, comparing the hidden commission for each group shows that the hidden commission of the system users reduced by about half, while that of the non-users has not reduced at all. In fact, it seems to have increased since 2017.

Furthermore, the results of the t-tests described in the previous section reinforce this argument by revealing that the hidden commission for the users was not statistically significant – indicating very little, to no, opportunistic behaviour, while that for non-users was statistically significant – indicating the presence of a significant level of opportunistic behaviour. Given the two different outcomes for the two groups, we conclude that there is no evidence of information spillovers from the users to the non-users of the information sharing system.

Intuitively, information spillovers, if present, would be detected by non-users having some knowledge about the information sharing system. To this effect, a question was included in the survey questionnaire for the non-users of the system to elicit information indicating the familiarity of the non-users with the information sharing system.

The non-users were asked as to why they did not use the information system. Their responses are presented in Table 4.10.

Table 4.10: Reasons for not using the information sharing system

Reason for not using information sharing system	Number of farmers
I do know anything about it	29
I have very little information about it / I do not know how to use the system	10
I do not trust the information provided by the system	1
Total	**40**

From the 40 non-users who were interviewed, 29 reported that they had never heard of the information sharing system evaluated in this study (more commonly known in Zambia as the Lima Links system), while 11 were aware of the existence of it. Some of the farmers either did not trust the information contained in the system or they were not sure how it worked, and needed more information about it.

The results indicate evidence of very little to no knowledge about the information sharing system by the non-users of the system. This means that information about the system and its benefits have hardly diffused to the non-users of the system. The results presented in Table 4.9 were somewhat surprising, as they show that a large percentage of non-users of the system had never heard of it. This is odd, given that each tomato farmer was found to have been trading on the Soweto market for an average of 12 years, and that the information sharing system had been introduced to some farmers in the Soweto market in

2014. Farmers trading in the same market for about 12 years would be expected to have built relationships and therefore be able to share information about events, news or other occurrences in the market, such as the introduction or the use of the information sharing system.

The information provided in Table 4.9, Figure 4.7 and 4.8 clearly show the benefits that accrue to farmers who have access to and use the information sharing system, as compared with those who do not. These results may, therefore, indicate that farmers and traders who used the information sharing system might not have wanted the others to know that they benefited from the using the information sharing system. This might be because the users of the system feared losing out on the benefits of using the information sharing system, should many farmers access price information from the information sharing system.

This is an indication of the immobility of information among the farmers, and yet this information could be beneficial, if adequately shared. It implies that the farmers play a passive role in the process of acquiring information from the system, as opposed to active participation in the process by acquiring information from the system and sharing it, as well as its perceived benefits. If the majority of the non-users of the information sharing system are unaware of it, one would not expect them to pursue information concerning the same system. The results here, then, show that information provided by the information sharing system remains stagnant, as it mainly remains with the system users.

Similar results emerged from the study of Wolcott et al. (2008) who attributed such issues to the inadequacy or a complete lack of training on the use of ICTs, as well as the lack of knowledge about the benefits that may result from the use of ICTs. However, Martin's (2010) study concerning the diffusion of the use of mobile phones among small- and medium-size farm households in Uganda found that more use of mobile phones to access agricultural-based information was made by members of farmer groups than by those farmers who did not belong to any farmer group. Such arrangements promote interaction among farmers and facilitate information sharing and exchange. Van der Merwe et al. (2017) also showed the significance of farmer networks in supporting information sharing and addressing opportunistic behaviour.

The current study clearly indicates that the information sharing system of interest yields benefits for the farmers (users), but that this highly beneficial system is not well known by all the potential beneficiaries (non-users).

4.7.2 Agricultural information and sources of information

The main information needs and the important information sources used by the tomato farmers interviewed for this study are presented in this section. The results in the previous section, suggesting that there was a lack of information diffusion among the surveyed farmers at the Soweto market, prompt a few questions concerning the communication channels and information dynamics among horticultural supply chain players in this market. Of particular interest are issues to do with the type of agricultural information that these farmers need and seek, the information platforms used by the farmers to obtain this information, and how they interact with each other and other market actors.

The individual interviews conducted were used to ask farmers about their information needs, and to come up with a list of information sources by asking the farmers to list their most important agricultural information sources. In order to determine the important information sources for the farmers, the information sources identified in the individual face-to-face interviews were ranked by the tomato farmers in order of importance to them. The interview guide that was used to conduct FGDs included a section that was used for pairwise ranking.

For pairwise ranking, the sources of agricultural information identified from the individual interviews were presented as paired comparisons to the FGD participants. The FGD participants were then asked to state their most preferred source between the two. The ranking was done by using this information to fill a matrix. The three tables obtained from the FGDs for the users were consolidated to derive the overall ranking of information sources for the users. The same was done for the three focus groups of non-users.

To construct the overall ranking tables (one for the users and the other for the non-users), the information sources were firstly listed in one column in the table. Then, using the three tables from the FGDs, the number of times an information source was reported to be prioritised over another information source was recorded next to each information source

in the “frequency mentioned” column. Lastly, the information sources were ranked according to the frequency mentioned, with the most frequently mentioned ranked as the top one. This process was done in Microsoft Excel.

Agricultural information needs of Zambian tomato farmers

The 70 farmers who were interviewed for this study all reported having cell phones. Of the 70 farmers, 65 of them reported having mobile phones with internet browsers. However, only 30 of these farmers reported having used their internet browsers to search for agricultural information. This indicates a very low adoption and usage of an important resource such as the internet. Bhavnani et al. (2008) pointed out that this also applies in other developing countries and can be attributed to the fact that modern technology platforms lack language diversity, as the content on such platforms is difficult for locals to understand because it is not often available in local languages. Furthermore, Patil et al. (2009) obtained similar findings that indicated a low usage of the internet by some farmers in some part of India due to the lack of relevant content in their local languages.

To get a sense of the type of information the surveyed farmers seek, all the surveyed tomato farmers under the current study were asked about the type of agricultural information they mainly search for from various sources. As can be seen in Figure 4.8 below, of the 70 farmers, 40 farmers mainly searched for agricultural commodity price information, 24 searched for crop management information, and only 6 indicated to have mainly searched for information about available markets (apart from the Soweto market) for agricultural commodities.

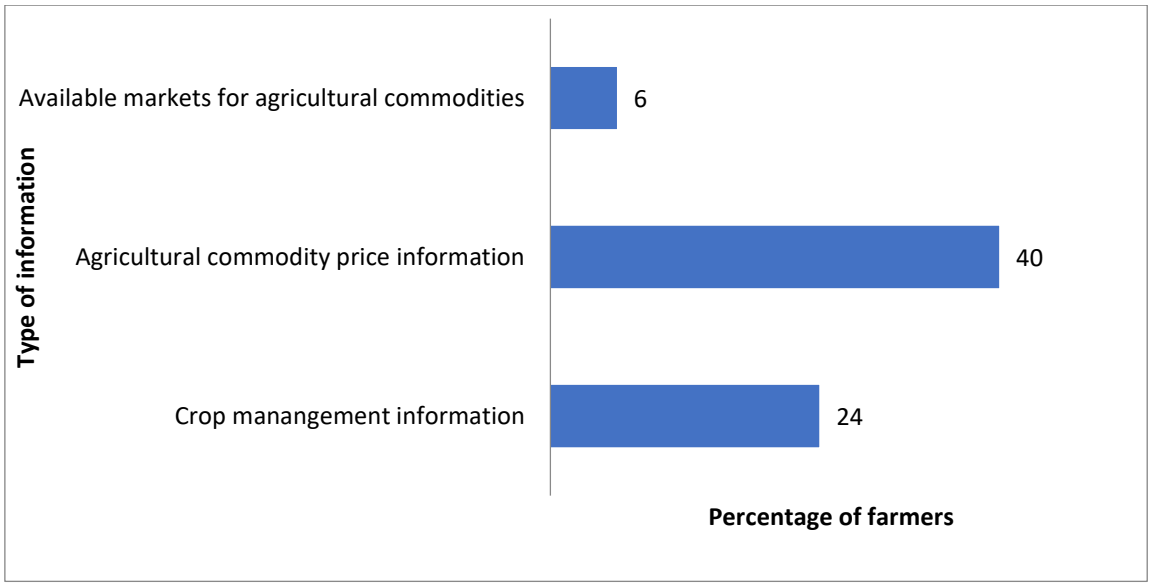

Figure 4.8: Typical information sought by tomato farmers in Zambia

From the information presented, it is clear that information sought by farmers who trade in the Soweto market is information that is highly essential in agriculture. Information about commodity prices, available markets, and crop management is required to assist farmers to decide whether to plant, or not to plant, tomatoes, how much of the crop to plant, what prices and ultimately profits can be expected, and where to market their products. Therefore, there is a risk of creating a barrier to entry into agricultural markets if this type of information is inadequate or unavailable.

It can also be seen from Figure 4.8 below that commodity price information and crop management information were most sought by the farmers. Price information is unarguably their top priority and this is not a surprising result because the majority of farmers, who trade in wholesale markets, produce relatively large quantities of tomatoes. Accordingly, they would like to estimate the profit that they are likely to make from their produce as they make production decisions. Moreover, tomato production is a relatively high capital and labour intensive enterprise, which makes it riskier to venture into, as compared with other enterprises. It is, therefore, vital for farmers to be aware of the financial gains to be obtained from such an enterprise.

In terms of crop management, this type of information is especially searched for by farmers involved in tomato-farm production because of the sensitive nature of tomatoes during the production process. Because farmers are aware that tomatoes are highly susceptible to diseases, pests, and weeds during the production process, it is expected that

they would be interested in acquiring crop management information, such as the type of agrochemicals that can be used to avoid loss in production. These findings echo the observations made by the Zambia Farmers Hub (2017), which reported that farmers in Zambia frequently request guidance on how to manage tomatoes during the production stage. In an earlier study, Nyirenda et al. (2011) highlighted the importance of knowledge on crop management among Southern African horticulture producers, more specifically regarding the management of pests.

Main sources of agricultural information for Zambian tomato farmers

The sources of agricultural information and modes of communication among market actors are just as important as communication itself is. These sources or channels facilitate the process of information sharing and determine the ease, frequency, and costs of information sharing and communication in general. With all the information needs of the tomato farmers described above, the sources of this information determine the accuracy, timeliness, and reliability of the information. These factors partly determine the usefulness of the information when farmers need to make economic decisions.

The main sources of agricultural information, as identified by the farmers, are presented in this section. The survey questionnaire was used to elicit information about the important agricultural information sources used by the tomato farmers. The information sources that were identified are brokers, other farmers, television, the internet, radio programmes, mobile phone applications, and extension workers. This information was then used in each of the 6 FGDs as a guide in creating a pairwise ranking table to determine the prioritisation of the information sources by the tomato farmers. The sources of information were presented as paired comparisons, and the FGD participants were asked to state which of the two sources they used the most often. The results of the pairwise ranking exercise for each FGD can be seen in Appendix C1 (page 109) for the three FGD groups of the users of the information sharing system, and Appendix C2 (page 110) for the three FGD groups of the non-users.

To determine the prioritisation of information sources for the group of non-users of the information sharing system under the current study, the information from the three pairwise ranking tables for the FGDs of the non-users was consolidated to create Table

4.11, below. Firstly, the information sources were listed. Then, using the three tables from the non-users FGDs, the number of times an information source was reported to be prioritised over another information source was recorded under the "frequency mentioned" column. Lastly, the information sources were ranked according to the frequency mentioned, with the most frequently mentioned ranked as the top one.

Table 4.11: Consolidated pairwise ranking of information sources for non-users of the information sharing system

Information source	Frequency mentioned	Rank
Broker	17	1
Radio programmes	14	2
Other farmer	12	3
Television	10	4
Extension workers	7	5
Internet browser	3	6
Mobile phone applications	0	7
Total Frequency of Measure	**63**	

As reflected by the ranking in Table 4.11, the tomato farmers in the non-user group indicated that the important information sources used by the farmers were the brokers, followed by radio programmes, then other farmers and television. The less frequently mentioned information sources were the extension workers (fifth place), the internet accessed through browsers (sixth place), and the lastly, mobile phone applications, at the bottom of the list.

These results show the heavy dependence of the non-users on the sharing of information by brokers. This is conceivably so because brokers have developed expertise in gathering market information through their frequent exposure to the market. Brokers are also the first point of contact for the farmers when they take their produce to the Soweto market, which makes the brokers the main source of price information for the non-users of the information sharing system. Unfortunately, the heavy reliance of the farmers on the brokers creates greater opportunities for the brokers to behave opportunistically towards the farmers by reporting misleading prices and thereby increasing their hidden commission.

When it comes to the radio as a source of information, farmers often acquire information on crop management practices from radio programmes. The specific programmes aired on

the Zambia National Broadcasting Cooperation (ZNBC) radio station are *Farming Today* and *Rural Notebook*. On these programmes, experts in the agricultural field are invited to share agricultural production information on selected topics such as crop or livestock management and farming methods/systems.

The low rankings of mobile phone-based applications and internet browsers suggest a low usage of modern technology and consequently indicate some resistance to embracing it. This can be attributed to the fact that there is little to no functional literacy and computer literacy in some communities in most developing countries. The relatively high cost of internet data may contribute to the low usage of internet browsers. Kameswari et al. (2011) found that one of the barriers to the use of ICTs, such as those that are mobile phone-based, by farmers in the Himalayan region was the low literacy levels in farming communities.

Moving on to the discussing regarding the ranking by the users of the information sharing system., the same procedure was followed for the FGD results of the users' information sources to create Table 4.12 below. It can be seen in Table 4.12 that this group ranked radio programmes as the source of agricultural information that they used the most. Mobile phone applications were ranked second, television was ranked as third, which was followed by internet browsers in fourth place. Extension workers were ranked seventh, with zero frequency of being mentioned.

Table 4.12: Consolidated pairwise ranking of information sources for users of the information sharing system

Information source	Frequency mentioned	Rank
Radio programs	15	1
Mobile phone applications	14	2
Television	12	3
Internet browser	11	4
Broker	6	5
Other farmer	5	6
Extension workers	0	7
Total Frequency of Measure	**63**	

Looking at Tables 4.10 and 4.11, it can be seen that there are major differences between the rankings of the two groups of farmers. For the current study, the relevant difference is the reliance of non-users on brokers as a source of information. In addition, unlike the non-users who indicated low usage of internet browsers and mobile phone applications, the group of users are indicated to have been more adept at using available technology. The high ranking of internet browsers and mobile phone technology showed some appreciation of modern technology by this group, although the information sharing system is not disseminated through the internet.

For both the users and non-users, it can be seen that radio programmes were ranked high (first and second, respectively). This might be explained by the availability and wide usage of small radios, which are also cheaply available; the availability of radio programmes in several local languages; and the fact that radio reception for various radio stations has wide geographical coverage in Zambia. Furthermore, radio programmes have evolved over time to include elements that engage the listeners. Farmers, for example, can ask questions and make other contributions to live radio programmes, using mobile phone calls. Those farmers who are more technologically adept and make use of their mobile phone applications can contribute via social media platforms, such as Facebook and Twitter.

In an earlier study, Svensson and Yanagizawa (2009) illustrated the use of radios as a tool for improving access to agricultural commodity price information, and consequently increasing incomes for poor households in Uganda. The results of their study suggest that farmers who obtained price information via radio programmes attained a stronger bargaining position when negotiating for farm-gate prices for their surplus produce.

Another point worth highlighting in the results in this section is the low ranking of extension workers as a source of agricultural information. Information from extension workers was ranked low by both system users and non-users. This was expected because the dissemination of appropriate agricultural information using agricultural extension workers has become increasingly inadequate, and more so when it comes to agricultural marketing information. The lack of agricultural marketing extension services for farmers, especially in developing countries, seems to be a common problem in agricultural markets because other studies, such as that of Dessalegn et al. (1998), have had similar findings that indicate the inadequacy of agricultural marketing extension services. According to Dessalegn et al. (1998), the typical structure of extension service systems rarely incorporates market information. To the contrary, Zanello (2012) found evidence in northern Ghanaian food crop markets which indicated that agricultural extension workers are among the most effective of information sources, and are associated with increasing market participation by farmers. The success of these service depend greatly on the way in which governments manage, monitor and regulate these officials, and this might be the reason why there is success in some cases, but not in all.

Similarly, Kameswari et al. (2011) found that the main sources of agricultural information in the Himalaya region of India were middlemen, government officers (extension officers) and other farmers (interpersonal networks). These sources of information were ranked according to their credibility. The results indicate that government officers constituted the most credible source of agricultural information, followed by other farmers, with middlemen being the least credible source. The high credibility of extension workers was attributed to the lack of personal agendas on the part of these extension workers and the formal training they received, which equipped them with relatively better technical know-how.

The results and discussion in this section indicate that middlemen such as brokers actively participate in providing agricultural information. However, their credibility as a source of market information is questionable. The results indicate that non-users of the information sharing system in the Soweto market rely on their brokers for market information, while users reported that they seldom used brokers as an information source. The dependence on

brokers for information has been explained by the absence of easily accessible alternative formal sources of price information.

4.8 Summary of the main findings

The analysis conducted, using Porter's Five Forces Model, revealed that five forces affect broker competitiveness, with different intensities. The results indicate that competitiveness among tomato brokers on the Soweto market is strongly affected by the threat that farmers might switch brokers and by the bargaining power of tomato buyers. It is, however, only moderately affected by competitive rivalry among brokers and the bargaining power of tomato farmers. The threat of new brokers entering the business barely affects broker competitiveness on the Soweto market. Also, the renegotiation process was reported to still be a challenge, especially for the non-users of the information sharing system. This was reported to be because of the lack of cold storage facilities or any proper storage facilities.

The test for opportunistic behaviour using the hidden commission revealed different results for the users and non-users. It was determined that the users of the information sharing system were charged a hidden commission of 5.37%, compared with the non-users who were found to be charged a hidden commission of 12%. The 5.37% hidden commission was found to be statistically insignificant, while the hidden commission of 12% was found to be statistically significant. This implies that the users of the information sharing system were found not to be exposed to broker opportunistic behaviour, while the opposite is true for non-users. However, there were no indications of information spillovers between the users and the non-users, as over 70% of the non-users reported that they did not know anything about the information sharing system. This calls for steps to be taken to increase awareness about the availability of such interventions.

Finally, the process of determining the information needs of the tomato farmers revealed that price information was reported to be the type of information most sought out by the farmers. The information sharing system is, therefore, important as it provides this information. Furthermore, the non-users of the information sharing system ranked the brokers and radio programmes as their most important sources of market information. This result indicates that non-users of the information sharing system are still highly dependent

on brokers to acquire market information. The users ranked radio programmes and mobile phone applications highly as their sources of agricultural information.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the research problem

Brokers who operate on the largest horticulture market in Zambia, the Soweto market, exhibit opportunistic behaviour in their transactions with the tomato farmers who they provide brokerage services to. This mainly occurs because of the presence of information asymmetry that characterises the market; farmers rarely have access to price, supply, or demand information, while brokers do. Brokers exploit farmers by selling tomatoes at higher prices than agreed on with the farmers in order to earn more commission (hidden commission) in addition to the transparent commission of about 10% of the total sales which they agree on with the farmers.

When brokers inflate tomato prices on the market, tomato sales slow down. This results in the spoilage or quality deterioration of tomatoes, and farmers bear the risk in such situations. This problem is reinforced by the lack of physical infrastructure on the market, notwithstanding the fact that highly perishable products require proper storage facilities. The farmers end up with little to no profits as a result of this, and this has a devastating effect on their livelihoods, given that most of the small-scale farmers are perpetually resource constrained.

A mobile phone information sharing system was introduced to provide a platform to enable farmers to access price information for several horticultural markets in Zambia. This was meant to address the information asymmetry problem, with the aim of consequently reducing opportunistic behaviour of brokers. However, it is unclear whether the information sharing has had the intended effect on the behaviour of tomato brokers.

5.2 Revisiting the objectives

This study assessed the effect of the use of a cell phone-based information sharing system on the opportunistic behaviour of Soweto market brokers in Zambia. This was achieved by specifically: (i) determining the perceptions of the users and non-users of the information

sharing system about the tomato brokerage system and broker behaviour; (ii) determining whether the use of the mobile phone information system had reduced the hidden commission charged by Zambian tomato brokers since the last study in 2010; (iii) determining if there were information spillovers of the mobile phone information sharing system from the users to the non-users of the system; and (iv) identifying the main information needs and important information sources used by the tomato farmers.

It was hypothesised that: (i) the mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are equal for the farmers who use the mobile phone based information sharing system; (ii) the mean first seller tomato price and the mean wholesale tomato price negotiated by brokers are not equal for the farmers who do not use the mobile phone based information sharing system; (iii) there is diffusion of information regarding the mobile phone information sharing system from the users to the non-users of the system.

5.3 Summary of the data and methods used

The data used for the analyses were collected from two groups of tomato farmers (30 users of the information sharing system and 40 non-users) who used the Soweto market in Zambia. For each group, the mean hidden commission was calculated by finding the difference between the first seller price and the wholesale price. A t-test was conducted on each of the mean hidden commission results from the two groups to determine whether there was a statistically significant difference between the first seller price and the wholesale price (which is the hidden commission) for each group.

While the main information sources were identified by using the individual interviews, determining their importance was done through FGDs, using pairwise ranking. Both the individual interviews and FGDs were used to determine the perceptions of the users and non-users of the information sharing system about the tomato brokerage system. This was done by analysing broker competitiveness using Porter's model, and also analysing price renegotiation between brokers and tomato farmers.

5.4 Summary of the results

While the mean hidden commission of 5.37% for the users of the system was not statistically significant, the mean hidden commission of 12% for the non-users of the system was found to be statistically significant. This was an indication of the absence of opportunistic behaviour in transactions involving users of the system, and the presence of opportunistic behaviour in transactions involving non-users of the system. In addition, the farmers were asked about their perceptions with regard to the effect of the use of the information sharing on hidden commission. Overall, the results indicated that the farmers were of the view that the use of the system reduced hidden commissions.

Porter's analysis revealed that the level of competitiveness among brokers on the Soweto market is moderate. The brokerage system was found to be characterised by the presence of a strong threat of switching brokers and a strong force of bargaining power of tomato buyers, the moderate rivalry and bargaining power of tomato farmers, and a weak threat of new brokers entering the market.

In terms of agricultural information, the farmers indicated that they mainly needed information about the price of agricultural commodities, as well as information on crop management. It was found that the users of the information sharing system obtained agricultural information mainly from radio programmes and information platforms, such as the information sharing system in question. The non-users of the information sharing system mainly obtained agricultural information from brokers and radio programmes. However, in both cases, extension services were indicated as being the least important information source used by the tomato farmers.

It can be concluded that the use of the mobile phone-based information sharing system reduced brokers' opportunistic behaviour. This reduction can be observed by the observed reduction of the hidden commission charged by brokers. This was reinforced by the results obtained from the analysis of the users' perceptions, with about 75% of the farmers indicating that the use of the information sharing system resulted in at least a slight reduction in brokers' hidden commission. However, there were no indications of information spillovers from the users to the non-users. This was an indication of poor communication regarding market information among the tomato farmers surveyed under this study. The benefits obtained from the use of the information sharing system were

limited in the sense that there were many potential beneficiaries who were unaware of it. More than 70% of the non-users of the information sharing system reported that they were not aware of it.

Furthermore, the benefits that might be obtained from reducing broker opportunistic behaviour through the reduction of information asymmetries may be subjected to a few caveats. The caveats arise from the fact that there are other elements of the transactions between tomato brokers and farmers that are likely to hinder the users of the information sharing system from acquiring the full benefits of using the information sharing system. For instance, the lack of storage infrastructure at the Soweto market is a caveat in this case. As such, it is clear that providing an information sharing system is not a panacea for all challenges related to the opportunistic behaviour of brokers on the Soweto market. Instead, the other caveats still need to be addressed in order to fully take advantage of the benefits of reduced opportunistic behaviour, and to encourage participation of farmers in horticulture markets in Zambia.

5.5 Managerial and policy recommendations

In light of the findings and conclusion of the present study, a number of managerial and policy recommendations are made.

Proper enforcement of the Markets and Bus Stations Act is required to address FGD participants' concern regarding non-competitive broker behaviour, which is barely regulated. This is because appropriate management arrangements for markets are outlined within the Markets and Bus Stations Act. This legal framework accommodates the needs of the farmers, brokers and other market players. However, the Soweto market currently operates in a legal vacuum because the behaviour of market players such as brokers is not being regulated. Therefore, there is a need for the authorities to work towards the enforcement of the Markets and Bus Stations Act which would contribute to regulating broker behaviour, and encourage competition among brokers in order to break the non-competitive behaviour created by the brokers. Some good lessons can be learned, for example, from the horticultural system in South Africa. Fresh produce markets in South Africa have a good regulatory system, to the extent that the financial records of brokers are

subject to inspection. This is likely to increase farmers' bargaining power and ensure low susceptibility of farmers and other traders to opportunistic behaviour by brokers.

Providing market information systems or platforms may address challenges regarding the lack of transparency that leads to information asymmetries, which contribute to increasing transaction costs and opportunistic behaviour in domestic agricultural markets. This is especially the case in Africa, where informal markets are the order of the day. The results indicate that the non-users of the information sharing system rely heavily on brokers for price information. This is a challenge in the sense that the brokers are the same market actors that might behave opportunistically and can, therefore, not be relied on to provide factual price information to the non-users of the system.

In light of this, encouraging investments in the provision of formal market information platforms would address the transparency and information asymmetry problem. The widespread use of mobile phones makes it relatively easier to introduce platforms that are mobile phone based. As indicated by the results of the present study, providing mechanisms for market actors, at either the same level or at different stages of the supply chain, to gain access to the same market information may create a balance of bargaining power among all interested parties. Also, efforts should be made by the providers of such services to sensitise all the potential users and beneficiaries of such systems through training and other dissemination exercises that would involve the active participation of all the relevant market actors.

Additionally, the responsibility to provide market information should not be left to the public sector only. As indicated by the results, extension services from the public sector are hardly relied on when it comes to market information. This can be attributed to the inefficient public sector extension service system, which is unable to deliver timely and/or adequate market information due to human resource and financial constraints. This underscores the need for the involvement of the private sector in the provision of market information. Private sector players could provide extension services at a fee because it is likely that users of the information provided would be willing to pay for it, if it is accurate and timely information, and there is consistency in supply. With the right financial incentives for investment, the private sector would target investing in lucrative sub-sectors such as horticulture.

Investment in improving the physical market infrastructure of the Soweto market would address another challenge highlighted by the FGD participants. The challenge involves the bad state of the market infrastructure which makes it impossible for farmers and traders to keep highly perishable produce in a good quality state for several days. Therefore, there is a need to cater for the high perishability of commodities such as tomatoes. The fact that tomatoes are highly perishable and cannot last for many days on the market is used as leverage by tomato brokers, who then behave opportunistically in market transactions. The absence of proper cold storage facilities or any proper storage infrastructure leaves farmers who have large quantities of fresh produce at a disadvantage in price negotiations, which may at times lead to losses. This is even worse during seasons when supply is very high and may result in farmers agreeing to sell at very low prices because they desperately need to avoid keeping their produce on the market for too long due to the fear of economic losses caused by spoilage and waste. The provision of infrastructure for storage, especially cooled storage, would therefore create a more conducive trading environment at the Soweto market. This is especially so for fresh produce farmers, as this would reduce the pressure of having to reduce commodity prices in an effort to avoid the deterioration of their produce. Initial investments and maintenance for such initiatives could be made through public–private partnerships.

Apart from the provision of soft infrastructure and platforms for communication, deliberate market policies targeted at improving communication and coordination in horticultural value chains may reduce the opportunistic behaviour exhibited by some market actors. The results of the present study indicate that physical interaction among market actors, such as tomato farmers who trade at the Soweto market, is limited. However, this is an important aspect of making value chains work. Hence, there is a need to implement market policies that require producers to work in organised groups with each other and/or with other market actors. This would facilitate horizontal coordination and information sharing. This could work in a similar way to that in which cooperatives work and may even assist these market actors to cope with various market risks, such as price risks, as they transact.

Meeting the aforementioned recommendations would eliminate, or at least reduce, some of the major institutional- and infrastructure-related barriers that Soweto market tomato farmers face when marketing their produce. The availability of cooled storage, bargaining in groups, and timely access to accurate price information would place tomato farmers in a

strong bargaining position. This, coupled with an effective legal framework to regulate the behaviour of all market actors, would create a conducive trading environment. The tomato farmers involved in these transactions would be less likely to incur large economic losses as a result of the opportunistic behaviour of brokers. Therefore, the profits obtained by farmers from selling tomatoes would no longer be eroded by losses from deterioration and spoilage of their tomatoes, or from agreeing to very low selling prices in an effort to sell all their produce within a short period of time. This would ultimately improve tomato farmers' livelihoods.

5.6 Opportunities for further research

As elaborated in Chapters One and Two, the result of the opportunistic behaviour exhibited by tomato brokers on the Soweto market is the deterioration and wastage of tomatoes. Unfortunately, this further results in farmers incurring economic losses from these transactions. An opportunity for further research would be to seek to determine the effect of the use of the information sharing system on the actual economic losses incurred by tomato farmers. For instance, by determining if there has been any reduction in the quantity of tomatoes wasted/spoiled that can be attributed to the use of this information sharing system. These research results could then be used to make a stronger case in terms of policy recommendations, particularly to support the importance of reducing opportunistic behaviour on these markets as much as possible. In addition, these results could also be useful in a cost–benefit exercise to motivate why investments in enhanced infrastructure on the Soweto market will lead to higher payoffs for all the interested parties.

REFERENCES

Abraham, R. 2008. Mobile Phones and Economic Development: Evidence From the Fishing Industry in India. The MIT Press.

Ahlers, C., Broll, U. and Eckwert, B. 2013. Information and Output in Agricultural Markets: the Role of Market Transparency. *Agricultural and Food Economics*, 1(1):15.

Aker, J.C. 2008. Does Digital Divide or Provide? The Impact of Cell Phones on Grain Markets in Niger. *Working Paper 154*. Washington, DC: Center for Global Development.

Aker, J.C. 2010. Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger. *American Economic Journal: Applied Economics*, 2(3): 46–59.

Akerlof, G.A. 1970. The Market for Lemons: Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economics*, 85: 488 – 500.

Amagoh, F. 2009. Information Asymmetry and the Contracting out Process. *The Public Sector Innovation Journal*, 14(2).

Angelucci, M. and De Giorgi, G. 2009. Indirect Effects of an Aid Program: How do Cash Transfers Affect Ineligibles' Consumption?. *The American Economic Review*, 99(1): 486-508.

Aryeetey, E. and Isinika, A.C. 2010. *African Smallholders: Food Crops, Markets and Policy*. CABI.

Asheeta, B., Rowena, W.C. and Subramam, J. 2008. The Role of Mobile Phones in Sustainable Rural Poverty Reduction. *ICT Policy Division Global Information and Communication Department (GICT).*

Bendre, M.R., Thool, R.C. and Thool, V.R. 2015, September. Big Data in Precision Agriculture: Weather Forecasting for Future Farming. In *Next Generation Computing Technologies (NGCT), 2015 1st International Conference on* (744-750). IEEE.

Bertrand, J.T., Brown, J.E. and Ward, V.M. 1992. Techniques for Analyzing Focus Group Data. *Evaluation Review*, 16(2): 198-209.

Bhavnani, A., Chiu, R.W.W., Janakiram, S., Silarszky, P. and Bhatia, D. 2008. The Role of Mobile Phones in Sustainable Rural Poverty Reduction. Retrieved November 22, 2008.

Boadi, R.A., Boateng, R., Hinson, R. and Opoku, R.A. 2007. Preliminary Insights into M-Commerce Adoption in Ghana. *Information Development*, 23(4): 253-265.

Boos, D., & Hughes-Oliver, J. 2000. How Large Does n Have to be for Z and t Intervals? *The American Statistician*, 54(2): 121-128.

Bradach, J.L. 1997. Using the Plural Form in the Management of Restaurant Chains. *Administrative Science Quarterly*, 42(2): 276–303.

Brown, J.R., Dev, C.S. & Lee, D.J. 2000. Managing Marketing Channel Opportunism: The Efficacy of Alternative Governance Mechanisms. *Journal of Marketing*, 64(2): 51–65.

Brown, P., Lumpkin, T., Barber, S., Hardie, E., Kraft, K., Luedeling, E., Rosenstock, T., Tabaj, K., Clay, D., Luther, G. and Marcotte, P. 2005. Global Horticulture Assessment. *Scripta Hort*, 3: 1-134.

Camacho, A. and Conover, E., 2010. The Impact of Receiving Price and Climate Information in the Agricultural Sector.

Clarke III, I. 2001. Emerging Value Propositions for M-Commerce. *Journal of Business Strategies*, 18(2): 133.

Cohen, J. 1990. Things I Have Learned (So Far). *American Psychologist*, 45(12): 1304–1312.

Courtois, P. and Subervie, J. 2014. Farmer Bargaining Power and Market Information Services. *American Journal of Agricultural Economics*, 97(3): 953-977.

Dahlstrom, R. and Nygaard, A. 1999. An Empirical Investigation of Ex Post Transaction Costs in Franchised Distribution Channels. *Journal of Marketing Research*, 36(2): 160-170.

De Leeuw, E.D. 1992. *Data Quality in Mail, Telephone and Face to Face Surveys*. TT Publikaties, Plantage Daklaan 40, 1018CN Amsterdam.

De Silva, H., Ratnadiwakara, D. and Soysa, S. 2008. The Costs in Agriculture: from the Planting Decision to Selling at the Wholesale Market: a Case-study on the Feeder Area of the Dambulla Dedicated Economic Centre in Sri Lanka. In 3rd Communication Policy Research, South Conference, Beijing.

De Winter, J.C.F. 2013. Using the Student's T-test with Extremely Small Sample Sizes. *Practical Assessment, Research & Evaluation*, 18(10).

Delves, D. and Patrick, B. 2008. Agency Theory Summary. [Online] Available at: http://www.delvesgroup.com.

Dessalegn, G., Jayne T.S & Shaffer, J.D. 1998. Market Structure, Conduct, and Performance: Constraints on Performance of Ethiopian Grain Markets. Working Paper 8. Addis Ababa: Grain Market Research Project.

Djurfeldt, A.A., Djurfeldt, G. and Lodin, J.B. 2013. Geography of Gender Gaps: Regional Patterns of Income and Farm–Nonfarm Interaction Among Male and Female-headed households in Eight African Countries. *World Development*, 48: 32-47.

Donner, J. 2008. Research Approaches to Mobile Use in the Developing World: A Review of the Literature. *The Information Society*, 24(3): 140-159.

Emongor, R. and Kirsten, J. 2009. The Impact of South African Supermarkets on Agricultural Development in the SADC: a Case Study in Zambia, Namibia and Botswana. *Agrekon*, 48(1): 60–84.

Forum for Agricultural Research in Africa [FARA]. 2009. Inventory of Innovative Farmer Advisory Services using ICTs.

Foster, A.D. and Rosenzweig, M.R. 1995. Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture. *Journal of Political Economy*, 103(6): 1176-1209.

Gabre-Madhin, E.Z. 2001. Market Institutions, Transaction Costs, and Social Capital in the Ethiopian Grain Market (Vol. 124). International Food Policy Research Institute.

GHA Team, 2005. Global Horticulture Assessment, June 30, 2005. *International Programs Office, University of California, Davis*, CA, USA.

Ghoshal, S. & Moran, P. 1996. Bad For Practice: A Critique Of The Transaction Cost Theory. *Academy of Management Review*, 21(1): 13–47.

Giné, X. and Mansuri, G. 2011. Together we will: evidence from a field experiment on female voter turnout in Pakistan. *World Bank Policy Research Working Paper, 5692*.

Goyal, A. 2010. Information, Direct Access to Farmers, and Rural Market Performance in Central India. *American Economic Journal*: Applied Economics, 2(3): 22–45.

Groenewegen, J., Berg, A. and Spithoven, A. 2010. *Institutional Economics: An Introduction*. Basingstoke: Palgrave Macmillan.

Grossman, G.M. and Helpman, E. 1992. Protection for sale (No. w4149). National Bureau of Economic Research.

Grover, V., Teng, J.T.C. & Fiedler, K.D. 2002. Investigating the Role of Information Technology in Building Buyer-Supplier Relationships. *Journal of the Association for Information Systems*, 3: 217–245.

Gyan Analytics. 2014. Global Horticulture (2014 –2018)–Pink and Healthy. Gyan Research and Analytics Pvt. Ltd, Delhi, India.

Harriss, J., Hunter, J. & Lewis, C.M. 1995. *The New Institutional Economics and Third World development*, London: Routledge.

Hichaambwa, M. 2010. Developments in the Horticultural Supply Chains in Zambia, Lusaka: Food Security Research Project (FSRP).

Hichaambwa, M. and Munthali, N. 2015. Can Market Agents Play a Significant Role in Sustainable Horticultural Supply Chains Development in Zambia? A Case Study of Lima Links Horticultural Price Information System. *Technical Paper 4.* Lusaka: Indaba Agricultural Policy Research Institute.

Hichaambwa, M. and Tschirley, D. 2010. How are Vegetables Marketed into Lusaka? The Structure of Lusaka's Fresh Produce Marketing System and Implications for Investment Priorities. *Policy Synthesis 40*. Lusaka, Zambia: Food Security Research Project

Hichaambwa, M., Chamberlin, J., & Kabwe, S. (2015). *Is Smallholder Horticulture the Unfunded Poverty Reduction Option in Zambia? A Comparative Assessment of Welfare Effects of Participation in Horticulture and Maize Markets.* Lusaka: Indaba Agricultural Policy Research Institute.

Hildebrandt, N., Nyarko, Y., Romagnoli, G. and Soldani, E. 2015. Price Information, Inter-Village Networks, and "Bargaining Spillovers": Experimental Evidence from Ghana.

Hobbs, J.E. 1996. A Transaction Cost Approach to Supply Chain Management. *Supply Chain Management: An International Journal*, 1(2): 15–27.

Hogg, R.V. & Tanis, E.A. 2005. *Probability and Statistical Inference* 7th ed., Boston: Pearson

Holbrook, A.L., Green, M.C. and Krosnick, J.A. 2003. Telephone Versus face-to-face Interviewing of National Probability Samples with Long Questionnaires: Comparisons of Respondent Satisficing and Social Desirability Response Bias. *Public opinion quarterly*, 67(1): 79-125.

Huque, A.S. 2005. Contracting Out and Trust in the Public Sector: Cases of Management from Hong Kong. *Public Organization Review*, 5(1): 69–84.

Jagun, A., Heeks R., & Whalley J. 2007. Mobile telephony and developing country micro-enterprise: A Nigerian case study. Manchester: Institute for Development Policy and Management. Retrieved on March 24, 2009, from http://www.sed.manchester.ac.uk.

Jaworski, B.J. 1988. Toward a Theory of Marketing Control: Environmental Context, Control Types, and Consequences. *Journal of Marketing*, 52(3): 23–39.

Jayne T.S & Shaffer, J.D. 1998. Market structure, conduct, and performance: constraints on performance of Ethiopian grain markets. Working Paper 8. Addis Ababa: Grain Market Research Project ministry of Economic Development and Cooperation.

Jensen, R. 2007. The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector. *The Quarterly Journal of Economics*, 122(3): 879–924.

John, G. 1984. An Empirical Investigation of Some Antecedents of Opportunism in a Marketing Channel. *Journal of Marketing Research*, 21(3): 278-289.

Joseph, K. & Thevaranjan, A. 1998. Monitoring and Incentives in Sales Organizations: An Agency-Theoretic Perspective. *Marketing Science*, 17(2): 107–123.

Kameswari, V.L., Kishore, D. and Gupta, V. 2011. ICTs for Agricultural Extension: a Study in the Indian Himalayan Region. *The Electronic Journal of Information Systems in Developing Countries*, 48(1): 1-12.

Khumalo, K. 2017. Produce Markets Raided in Probe. *Cape Times*.

Kirmani, A. & Rao, A.R. 2000. No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality. *Journal of Marketing*, 64(2): 66–79.

Krueger, R.A. and Casey, M.A. 2014. *Focus Groups: A Practical Guide for Applied Research*. Sage Publications.

Lannon, J. 2012. *Human Rights and Information Communication Technologies: Trends and Consequences of Use: Trends and Consequences of Use*. IGI Global.

Lehmann, E. L. 2012. *"Student" and Small Sample Theory*. In Selected Works of E.L. Lehmann (pp. 1001–1008). Springer US.

Levenstein, M., Suslow, V. and Oswald, L. 2003. *International Price-fixing Cartels and Developing Countries: A Discussion of Effects and Policy Remedies* (No. w9511). National Bureau of Economic Research.

Lyberg, L. and Kasprzyk, D. 1991. Data Collection Methods and Measurement Error: An Overview. *Measurement Errors in Surveys*. Wiley, New York.

Madden, G. and Savage, S.J. 1998. CEE Telecommunications Investment and Economic Growth. *Information Economics and Policy*, 10(2): 173-195.

Makeche, S. 2016. Analysing Trader Behaviour in the Maize Marketing System in Zambia. Thesis.

Malapit, H.J., Sproule, K., Kovarik, C., Meinzen-Dick, R.S., Quisumbing, A.R., Ramzan, F., Hogue, E. and Alkire, S. 2014. *Measuring Progress Toward Empowerment: Women's*

Empowerment in Agriculture Index: Baseline Report. International Food Policy Research Institute.

Martin, B.L. 2010. Mobile Phones and Rural Livelihoods: An Exploration of Mobile Phone Diffusion, Uses, and Perceived Impacts of Uses among Small- to Medium-Size Farm Holders in Kamuli District, Uganda. MSc. Thesis. Iowa State University.

McDonald, J.H., 2009. Handbook of biological statistics (Vol. 2, pp. 173-181). Baltimore, MD: sparky house publishing.

McCullough, E.B., Pingali, P.L. and Stamoulis, K.G. 2008. The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers, London: Earthscan.

Miguel, E. and Kremer, M. 2004. Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities. *Econometrica*, 72(1): 159-217.

Mitnick, B.M. 2013. Origin of the Theory of Agency: An Account by One of the Theory's Originators.

Molony, T. 2008. Running out of Credit: the Limitations of Mobile Telephony in a Tanzanian Agricultural Marketing System. *The Journal of Modern African Studies*, 46(4): 637-658.

Morgan D L. 1998. *The Focus Group Guide Book*. London: Sage Publications.

Muendo, K.M., Tschirley, D. and Weber, M.T. 2004. Improving Kenya's Domestic Horticultural Production and Marketing System: Current Competitiveness, Forces of Change, and Challenges for the Future. *Working Paper 08/2004*. Tegemeo Institute Of Agricultural Policy and Development, Egerton University.

Murry, J.P. & Heide, J.B. 1998. Managing Promotion Program Participation within Manufacturer-Retailer Relationships. *Journal of Marketing*, 62(1): 58–69.

Muthini, N.D. 2015. An Assessment of Mango Farmers' Choice of Marketing Channels in Makueni, Kenya (No. 204866). Collaborative Masters Program in Agricultural and Applied Economics.

Muto, M. and Yamano, T. 2009. The Impact of Mobile Phone Coverage Expansion on Market Participation: Panel Data Evidence from Uganda. *World Development*, 37(12): 1887–1896.

Mwanaumo, A. 1999, June. Agricultural Marketing Policy Reforms in Zambia. In *Workshop on Agricultural Transformation in Africa, Nairobi, Kenya*.

Mwansakilwa, C., Tembo, G. and Mugisha, J. 2013. Growth and Competitiveness of Non-Traditional Agricultural Exports in Zambia. *Modern Economy*, 4(11): 794.

Mwiinga, M.N. 2009. An Assessment of Tomato Price Variability in Lusaka and Its Effects on Smallholder Farmers. Thesis.

Myhr, J. 2006. Livelihood Changes Enabled by Mobile Phones – the Case of Tanzanian Fishermen. Uppsala University, Department of Business. Thesis.

Nagalakshmi, T., Sudhakar, A., Raghuveer, K., Satya-Sudha, M and Phani-Krishna, U. 2013. Role of Commission Agents In Marketing Agricultural Products – A Case Study of Dharur Mandal, Ranga Reddy District – Andhra Pradesh-India. *International Journal of Business and Management Invention*, 2(12): 33–47.

Nagin, D.S., Rebitzer, J.B., Sanders, S. and Taylor, L.J. 2002. Monitoring, Motivation, and Management: The Determinants of Opportunistic Behavior in a Field Experiment. *American Economic Review*, 92(4): 850-873.

Ndanga, L.Z.B., Quagrainie, K., Ngugi, C.C. and Amadiva, J. 2015. Application of Porter's Framework to Assess Aquaculture Value Chain in Kenya. African Journal of Food, Agriculture, Nutrition and Development, 15(3): 10118-10137.

Ngugi, I.K., Gitau, R. & Nyoro, J.K. 2006. Access to High-value Markets by Smallholder Farmers of African Indigenous Vegetables. [Online] Available at: http://pubs.iied.org/pdfs/G03254.pdf

Nyirenda, S.P., Sileshi, G.W., Belmain, S.R., Kamanula, J.F., Mvumi, B.M., Sola, P., Nyirenda, G.K. and Stevenson, P.C. 2011. Farmers' Ethno-Ecological Knowledge of Vegetable Pests and Pesticidal Plant Use in Malawi and Zambia. *African Journal of Agricultural Research*, 6(6): 1525-1537.

Park, H.M. 2009. Comparing Group Means: T-tests and One-way ANOVA Using STATA, SAS, R, and SPSS. *Working Paper*. The University Information Technology Services (UITS) Center for Statistical and Mathematical Computing, Indiana University.

Patil, V.C., Gelb, Ehud, Yaduraju, N.T., Moni, M. and Patil, Roopa. S. 2009. Web based agriculture in India.

Pascual-Ezama, D., Prelec, D. and Dunfield, D., 2013. Motivation, Money, Prestige and Cheats. *Journal of Economic Behavior & Organization*, 93: 367-373.

Porter, M.E. and Millar, V.E. 1985. How Information Gives You Competitive Advantage. Harvard Business Review (63)4: 149-160.

Powell, R.A. and Single, H.M. 1996. Focus Groups. *International Journal for Quality in Health Care*, 8(5): 499-504.

Qu, Y. and Loosemore, M.. 2013. A Meta-Analysis of Opportunistic Behaviour in Public-Private Partnerships: Manifestations and Antecedents. *Reading, Association of Researchers in Construction Management*.

Rachapila, T. and Jansirisak, S. 2013. Using Porter's Five Forces Model for Analysing the Competitive Environment of Thailand's Sweet Corn Industry. *International Journal of Business and Social Research*, 3(3): 174-184.

Ramaswami, N.S., Srinivasan, S. S. & Gorton, A.S. 1997. Information Asymmetry Between Salesperson and Supervisor: Postulates from Agency and Social Exchange Theories, *Journal of Personal Selling & Sales Management*, 17(3): 29-50.

Rhiel, G.S. & Chaffin, W.W. 1996. An Investigation of the Large-Sample/Small-Sample Approach to the One-Sample Test for a Mean (Sigma Unknown). *Journal of Statistics Education*, 4(3).

Richards, P. 2002. Cultivation: Knowledge or Performance?. In *An Anthropological Critique of Development*. Routledge.

Russell, T., 1997. Pairwise Ranking Made Easy. *PLA Notes*.25-26.

Ryu, K., Han, H. and Kim, T.H. 2008. The Relationships mong overall Quick-Casual Restaurant Image, Perceived Value, Customer Satisfaction, and Behavioral Intentions. *International Journal of Hospitality Management*, 27(3): 459-469.

Seager, R., Ting, M., Held, I., Kushnir, Y., Lu, J., Vecchi, G., Huang, H.P., Harnik, N., Leetmaa, A., Lau, N.C. and Li, C. 2007. Model Projections of an Imminent Transition to a more Arid Climate in Southwestern North America. *Science*, *316*(5828): 1181-1184.

Shirouzu, N. and Bigness, J. 1997. 7-Eleven Operators Resist System to Monitor Managers. *Wall Street Journal*, (June 16), BI, B5

Steele, H.L. & Scott, G.J. 1987. Markets, Myths and Middlemen: A Study of Potato Marketing in Central Peru. *American Journal of Agricultural Economics*, 69(1): 205.

Steinle, C., Schiele, H. & Ernst, T. 2014. Information Asymmetries as Antecedents of Opportunism in Buyer-Supplier Relationships: Testing Principal-Agent Theory. *Journal of Business-to-Business Marketing*, 21(2): 123–140.

Steurs, G.V.G. 1997. Spillovers and Cooperation in Research and Development. Thesis. Faculty of Economics and Applied Economics, Katholieke Universiteit Leuven.

Svensson, J. and Yanagizawa, D., 2009. Getting Prices Right: the Impact of the Market Information Service in Uganda. *Journal of the European Economic Association*, 7(2-3): 435-445.

The European Union. 2013. Agribusiness and Development: How Investment in the African Agri-food Sector Can Help Support Development. Charlemagne, Brussels. The European Union.

The Government of the Republic of Zambia. 2016. *Start-Up Policy.* Lusaka, Zambia.

Tschirley, D. and Hichaambwa, M. 2010. The structure and Behaviour of Vegetable Markets Serving Lusaka: Main Report 1. *Working Paper 46*. Lusaka, Zambia: Food Security Research Project.

Tschirley, D., Hichaambwa, M. & Mwiinga, M. 2011. Comparative Assessment of Marketing Structure and Price Behaviour of Three Staple Vegetables in Lusaka, Zambia.

In *Vegetable Production & Marketing in Africa: Social Economic Research*. London: CABI: 127–148.

Tschirley, D., Hichaambwa, M., Ayieko, M., Cairns, J., Kelly, V. and Mwiinga, M., 2012. Fresh Produce Production and Marketing Systems in East and Southern Africa–A Comparative Assessment. *Michigan State University's Guiding Investments for Sustainable Agricultural Markets in Africa Project*, Michigan State University, East Lansing, Michigan.

Van der Merwe, M., Kirsten, J.F. and Trienekens, J.H. 2017. Information Sharing as a Safeguard against the Opportunistic Behavior of South African Karoo Lamb farmers. *Agricultural Economics*, 48(S1): 101-111.

Verbeke, W. 2005. Agriculture and the Food Industry in the Information age. *European Review of Agricultural Economics*, 32(3): 347-368.

Wathne, K.H. & Heide, J.B. 2000. Opportunism in Interfirm Relationships: Forms, Outcomes, and Solutions. *Journal of Marketing*, 64(4): 36–51.

Welch, B. 1958. `Student' and Small Sample Theory. *Journal of the American Statistical Association*, 53(284): 777-788.

Williamson, O.E. 1985. `The Economic Institutions of Capitalism. *Antitrust Bulletin*. NY: Free Press.

Williamson, O.E. 1975. *Markets and hierarchies*. New York.

Wolcott P., Kamal M., and Qureshi S. 2008. Meeting the challenges of ICT adoption by micro-enterprises. *Journal of Enterprise Information Management*, 21(6): 620-628.

Zabell, S. L. 2008. On Student's 1908 Article "The Probable Error of a Mean". *Journal of the American Statistical Association*, 103: 1–7.

Zambia Farmers Hub (2017). [Online] Available at: https://zambiafarmershub.wordpress.com. Accessed on 24 December, 2017.

Zambia Information and Communication Technology Authority. 2015. *ICT Survey Report –Household and Individuals*. Lusaka.

Zanello, G., 2012. Mobile phones and radios: Effects on Transactions Costs and Market Participation for Households in Northern Ghana. *Journal of Agricultural Economics*, 63(3): 694-714.

APPENDIX A: FARMER QUESTIONNAIRE

THE HORTICULTURAL PRICE INFORMATION SHARING SYSTEM IN ZAMBIA: TOMATO FARMER CHARACTERISTICS AND FARMER – BROKER TRANSACTIONS

LEK 890 Dissertation (Eustensia Munsaka)
Department of Agricultural Economics, Extension and Rural Development
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Dear Respondent,

You have been randomly selected as part of a sample to fill in this questionnaire on the topic stated above. You are kindly requested to answer this questionnaire as truthfully as possible. Be assured that the information you provide will be treated confidentially.

Date of Interview: _____

Farmer code _____

Gender of the farmer 1=Male 2=Female

SECTION 1: FARMER CHARACTERISTICS

1.1. What is your age? _____

1.2. Is farming your main source of income?_____

1.3. How long have you been farming?_____ *years* *(enter 0 if less than 1 year)*

1.4. What is your highest educational level attained?

1=None 2=Primary 3=Secondary 4=Tertiary *If 1,2 or 3, go to question 1.6*

1.5. Was your tertiary education in agriculture? *1=Yes 2=No*

1.6. Do you have a mobile phone? *1=Yes 2=No* *If No, go to question 1.13*

1.7. What is your cell phone number?

0	*9*								

1.8. Does your mobile phone have an internet browser?
1=Yes 2=No *If No, go to question 1.12*

1.9. Do you ever use your mobile phone internet browser to search for information?
1=Yes 2=No *If No, go to question 1.12*

1.10. How often do you use your mobile phone internet browser to search for information?
1=Never 2=Rarely 3=Sometimes 4= Often 5= Always

1.11. Do you use your mobile phone internet browser to search for agricultural information?
1=Yes 2=No *If No, go to question 1.12*

1.12. As a farmer, what kind of agricultural information do you need/search for?
_____

1.13. How far is your farm from the Soweto market? _____ *(Km)*

1.14. How many years have you been trading on the Soweto market? _____

1.15. How many crates of tomatoes did you harvest for sale in 2016? _____

1.16. Please provide the information required in the table below for each type of fresh produce that you trade on the Soweto market.

Table 1: Crops grown and trade on the Soweto market

Crop	**Percentage of total produce planted**	**Harvest**	
		Quantity	**Unit**
Tomato			

1.17. Do you think brokers on the Soweto market are honest when it comes to pricing your product? *1=Yes 2=No 3=Not sure*

1.18. Do you think brokers on the Soweto market are honest when it comes to commission? *1=Yes 2=No 3=Not sure*

SECTION 2: TRANSACTION CHARACTERISTICS

2.1. Did you have information about the price of tomato before you negotiated with the broker today? 1=*Yes* *2=No* *if No, go to 2.3*

2.2. What was the source of the price information in 2.1?_____

2.3. At what price did you and the broker agree on to sell your tomatoes? _____*ZMW/Crate*

2.4. How much broker commission did you and the broker agree on? _____*% of total sales*

2.5. From this transaction, how much did you walk away with? _____ *ZMW*

2.6. Have you ever switched brokers? *1=Yes 2=No* *if No, go to 2.9*

2.7. What was the reason for switching brokers?
_____

2.8. How honest would you say your broker is honest when it comes to pricing your product?

1=Not at all honest 2=Slightly honest 3= Somewhat honest 4= Very honest 5= Extremely honest

2.9. How often in one transaction does the broker contact you to renegotiate the price?

1=Never 2=Rarely 3=Sometimes 4= Often 5= Always if never, go to 2.11

2.10. Please describe how you arrive at the new price in 2.9

_____

2.11. What reasons does the broker provide for adjusting prices?

_____

2.12. Do you think the amount of commission charged by the brokers is fair?

1=Yes 2=No 3=Not sure

2.13. Please give a reason for your answer in 2.12

_____

2.14. How satisfied are you with the services provided by your broker?

1=Very dissatisfied 2=Dissatisfied 3=Unsure 4= Satisfied 5= Very satisfied

2.15. Have you ever had any conflict about commission with your broker? *1=Yes 2=No*

2.16. Please describe the conflict in 2.*15*

_____

2.17. Have you ever had any conflict about sales with your broker? *1=Yes 2=No*

2.18. Please describe the conflict in 2.*17*

_____

2.19. What is your main source of price information?
_____ (most important)

_____

_____ (least important)

2.20. Do you use the Lima Links market information sharing system?
1=Yes *2=No* *if Yes, go to section 3*

2.21. Reason for your answer in 2.20

_____

2.22. Do you approach Lima Links users to get price information? *1=Yes* *2=No*

End of Interview for non-users: Thank the respondent

The next section (Section 3) is only for farmers that use the Lima Links information sharing system

SECTION 3

3.1. When did you start using the Lima Links system? *Month*_____*Year*_____

3.2. Why did you start using the Lima Links system?

_____

3.3. Do you use the Lima Links system for other fresh produce apart from tomatoes?
1=Yes *2=No*

3.4. Do others come to you for the price information you obtain from the system?
1= Yes *2=No* *if No, go to question 3.6*

3.5. Do you share it with them? *1= Yes* *2=No* *if yes, go to 3.7*

3.6. Reason for answer for 3.5

_____

3.7. How do you communicate this information with them?

1=Face to face 2=Phone call or text message 3=Other (specify) _____

3.8. Have you ever had any conflict about sales with your broker since you started using the system? *1=Yes 2=No if no, go to 3.10*

3.9. Please describe the conflict in 3.*8*

_____

3.10. Have you ever had any conflict about commission with your broker since you started using the system? *1=Yes 2=No if no, go to 3.12*

3.11. Please describe the conflict in 3.*10*

_____

3.12. On a scale of 1 to 5 to what extent did the Lima system reduce the hidden commission?

1=Not at all 2=Slightly reduced 3=Somewhat reduced

4= Moderately reduced 5= extremely reduced

End of Interview: Thank the respondent

APPENDIX B: FOCUS GROUP DISCUSSIONS INTERVIEW GUIDE

THE HORTICULTURAL PRICE INFORMATION SHARING SYSTEM IN ZAMBIA: TOMATO FARMER CHARACTERISTICS AND FARMER – BROKER TRANSACTIONS

LEK 890 Dissertation (Eustensia Munsaka)
Department of Agricultural Economics, Extension and Rural Development
University of Pretoria

Dear Respondents,

You have been randomly selected as part of a sample to participate in a focus group discussion on the topic stated above. You are kindly requested to answer this provide true information during the discussion. Be assured that the information you provide will be treated confidentially.

Key respondents: Soweto market tomato farmers

- 3 groups of 6 farmers who use the Lima Links information sharing system
- 3 groups of 6 farmers who do not use the Lima Links information sharing system

1. The key issues to tackle here have to do with how these farmers share information. Information sources/ information sharing channels were identified from the individual interviews. Use pair-wise ranking to determine the important information sources (use the pairwise ranking matrix below).

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer									
2.Broker									
3.Internet browser									
4.Radio programs									
5.Television									
6. Mobile phone applications									
7. Extension worker									

2. Probe about price bargaining
    - How much bargain power do farmers and brokers have?
3. Probe about broker competition
    - Structure of rules and regulations
    - Enforcement of the rules and regulations
4. Probe about the price renegotiation that occurs when produce is not sold in on day

End of focus group discussion: Thank the participants

APPENDIX C1: PAIRWISE RANKING TABLES FOR SYSTEM USERS

FGD 1

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		2	3	4	5	6	1	1	6
2.Broker			3	2	5	6	2	2	5
3.Internet browser				4	5	6	3	3	4
4.Radio programs					4	4	4	5	1
5.Television						6	5	4	3
6. Mobile phone applications							6	5	1
7. Extension worker								0	7

FGD 2

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		1	3	4	5	6	1	2	5
2.Broker			3	4	5	6	2	1	6
3.Internet browser				3	3	6	3	5	1
4.Radio programs					4	4	4	5	1
5.Television						5	5	4	3
6. Mobile phone applications							6	4	3
7. Extension worker								0	7

FGD 3

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		1	3	4	5	6	1	2	5
2.Broker			3	2	5	6	2	2	5
3.Internet browser				4	5	6	3	3	4
4.Radio programs					4	4	4	5	1
5.Television						6	5	4	2
6. Mobile phone applications							6	4	2
7. Extension worker								0	7

APPENDIX C2: PAIRWISE RANKING TABLES FOR NON-USERS OF THE SYSTEM

FGD 1

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		1	1	4	1	1	1	5	1
2.Broker			2	2	2	2	2	5	1
3.Internet browser				4	5	3	7	1	6
4.Radio programs					4	4	4	5	1
5.Television						5	5	3	4
6. Mobile phone applications							7	0	7
7. Extension worker								2	5

FGD 2

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		2	1	1	5	1	1	4	2
2.Broker			2	2	2	2	2	6	1
3.Internet browser				4	5	3	7	1	6
4.Radio programs					4	4	4	4	2
5.Television						5	5	4	2
6. Mobile phone applications							7	0	7
7. Extension worker								2	5

FGD 3

Information source	Information source number							Score	Rank
	1	2	3	4	5	6	7		
1.Other farmer		2	1	4	5	1	1	3	3
2.Broker			2	2	2	2	2	6	1
3.Internet browser				4	5	3	7	1	6
4.Radio programs					4	4	4	5	2
5.Television						5	7	3	3
6. Mobile phone applications							7	0	7
7. Extension worker								3	3