MARKET ACCESS FOR SMALLHOLDER TOMATO FARMERS IN MASHONALAND EAST PROVINCE OF ZIMBABWE: AN ECONOMIC ANALYSIS

By

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THESIS

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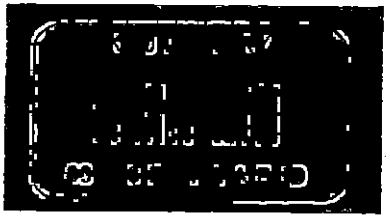

DEPARTMENT OF AGRICULTURAL ECONOMICS

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KERALA, INDIA

2014

DECLARATION

I, hereby declare that this thesis entitled **"Market access for smallholder tomato farmers in Mashonaland East Province of Zimbabwe: An economic analysis"** *is a bonafide* record of research work done by me during the course of research and that it has not been previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Market access for smallholder tomato farmers in Mashonaland East Province of Zimbabwe: An economic analysis"** is a bonafide record of research work done independently by **Mr. Emmanuel Zivenge (2011-21-119)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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Emmanuel Zivenge

Dedicated to my mother
Eugenia

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ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dicker Fuller
AGRITEX	Agricultural Technical and Extension Services
AKDN	Aga Khan Development Network
AMA	Agricultural Marketing Authority
ARDA	Agricultural Rural Development Agency
C.S.O	Central Statistical Office
CARE	Cooperative for Assistance and Relief Everywhere
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
ESAP	Economic Structural Adjustment Program
FAOSTAT	*Food and Agriculture Organization Statistics*
FTLRP	Fast Track Land Reform Program
GMB	Grain Marketing Board
GoZ	Government of Zimbabwe
HRI	Horticultural Research Institute
IAD	Institutional Analysis and Development
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
KI	Key Informants
LRRP	Land Reform and Resettlement Program
MAIM	Ministry of Agriculture, Irrigation and Mechanisation
MoAMID	*Mechanization and Irrigation Development*
NGO	Non Governmental Organisations
POTRAZ	Postal and Telecommunications Regulatory Authority of Zimbabwe
RUM	Random Utility Model
SCP	Structure-Conduct-Performance
VAR	Vector Autoregressive Model
VECM	Vector Error Correlation Model

VRS	Variable Returns to Scale
ZFC	Zimbabwe Fertilizer Company Limited
ZFU	Zimbabwe Farmers Union
ZIMSTAT	Zimbabwe National Statistics Agency
ZINWA	Zimbabwe National Water Authority

INTRODUCTION

1. INTRODUCTION

As key organising principals of economic activity, providing the structure and processes to determine what is produced and consumed, markets are at the heart of successful economic growth. Countries that have been successful in reducing poverty have utilised and shaped markets to provide the right conditions to allow people to raise their incomes. They have made the markets in which the poor exist as consumers, producers and workers work more effectively and efficiently. The efficiency of markets is shaped by their immediate environment. Low population density in rural areas, remote location and high transport costs present difficulties in accessing markets. The rural poor are also constrained by their lack of understanding of the markets, limited business and negotiating skills and lack of an organization that could give them the bargaining power they require to interact on equal terms with other, larger and stronger market intermediaries.

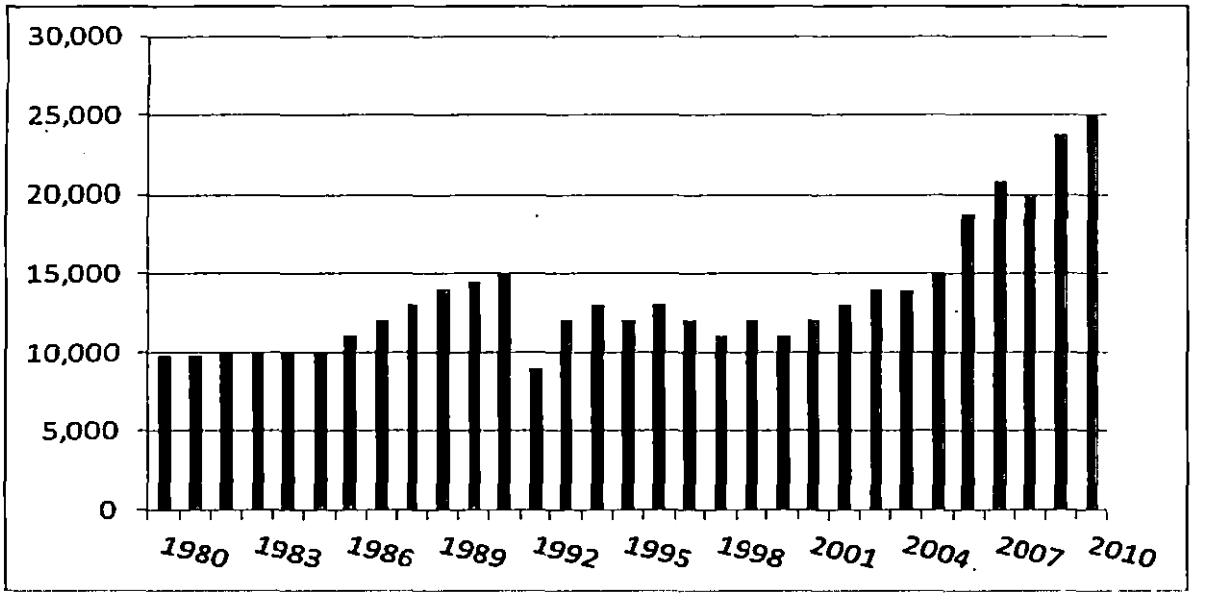
Rural households have diverse livelihood strategies, encompassing a range of activities. For most, agriculture is a key element of their strategy. Interacting with agricultural markets is thus an important aspect of the livelihood strategies of many rural households, rich and poor alike. Virtually all households in rural areas are, by preference, producers, consumers, buyers and sellers. Many rural households sell agricultural produce and buy their food at different times of year. For these reasons, assisting rural poor people in improving access to markets must be a critical element of any strategy to enable them to enhance their food security and increase incomes.

Government of Zimbabwe identified rural development as one of its top priorities and placed agriculture at the centre of its strategy as a result of land reform program that ended in 2006. Approximately 75 per cent of arable land is in the hands of smallholder farmers (Moyo, 2008). Thus, linking smallholder farmers with markets has been identified as one of the major issues in policy and practice in improving livelihoods for millions of poor in the country. Efficient agricultural markets are viewed as a potent tool for poverty reduction. Liberalisation of horticultural marketing systems by the government is a way to empower smallholder farmers to sell their produce at competitive prices.

Over the last decade Zimbabwe' smallholder horticultural production expanded with vegetable sector taking a lead. Tomato is among the most important vegetables grown by smallholder farmers as food and cash crop in the country. According to Food and Agriculture Organization Statistics (FAOSTAT, 2010) tomato (*Solanum lycopersicum* L.) is the most important fruit crop in the world. Tomato in Zimbabwe is consumed in diverse ways including raw, as an ingredient in many dishes especially in stews to complement the staple diet of maize meal or a variety of processed products such as paste, whole peeled tomatoes, diced products and various forms of juice, sauces and soups.

Tomatoes are usually produced almost throughout the year in different areas of the country. Tomatoes are produced in almost all provinces. Mashonaland East Province and Manicaland are the major production areas. The provinces account for more than 85 per cent of the total area under tomato. Figure 1.1 shows tomato production between 1980 and 2010.

Figure: 1.1 Tomato Production in Zimbabwe (metric tonnes)



Source: FAOSTAT, 2010

1.1 Market structure

Starting in the early 1990s, Zimbabwe undertook a number of structural reforms to improve the market and external orientation of the economy. Under the Economic Structural Adjustment Program (ESAP, 1991 – 95), substantial progress was made in liberalising the trade and foreign exchange regime, deregulating agricultural marketing and opening up the financial sector. Parts of the economy responded very well to the reform initiatives. High rates of output growth were achieved in several sectors, in particular, in sectors that catered to the international market and had an equity base large enough not to be negatively affected by the domestic interest rates. Horticulture responded well to economic liberalization. The government is no longer directly involved in the pricing or performance of physical functions of tomato marketing. Its role has been minimal, mainly confined to facilitative functions. The remarkable performance of the industry has been ascribed to this policy, which engendered autonomy in production and marketing decisions thus fostering significant local private initiatives and dynamism within the industry. The local tomato market is very open; hence prices are determined by supply and demand factors.

Tomato is one of the main vegetables used for hawking by small-scale entrepreneurs in the informal sector. In terms of the distribution of vegetables, 46 per cent of production is sold through the fresh produce markets, 42 per cent through direct sales and own consumption, 10 per cent are processed and 2 per cent of tomatoes are exported (Government of Zimbabwe, 2010). It is estimated that tomato small scale sector produces about 60 per cent of all locally marketed tomato and the rest comes from the large commercial sector (Government of Zimbabwe, 2010). The formal market comprises supermarkets (OK, TM, SPAR, Food Chain and Bon Marche) and wholesalers (Interfresh, Favco, Freshpro, Harare Produce Sales). The prices are arrived at through a bargaining process by farmers who have a dual objective to collect the best prices for sales while ensuring that the highly perishable stocks are cleared. In the wholesale environment tomatoes are typically sold in bulk with a minimum of 10kg cartons and because price is negotiable, high volume buyers generally secure better deals than their small-scale counterparts.

Processing of tomatoes consists of canning, freezing, dehydration and juice. The leading players in the tomato processing industry are Tiger Brands, Nestle and Giants Canning and processors (Cairns).

The average household in Zimbabwe consumes between seven and ten kg of tomatoes per week. Population growth, urbanization per capita income and the income elasticity of demand for tomatoes are important factors influencing the demand for tomatoes. Total consumption as fresh vegetables was 16 137 metric tonnes, processed was 4 metric tonnes and consumption per capita was 1 metric tonnes in 2009.

Production and marketing of the crop provide employment for many people. It is necessary to prepare the next phase of development, market access. Smallholder farmers often face a number of barriers in accessing the high value markets.

1.2 Problem Statement

Normally, small-scale farmers living in rural areas market their produce with little choice about who they sell to or how much they charge. Desperate for money to pay back debts or maintain their households, smallholder farmers take the little they are offered, but never earn enough to make investments in their farming business or pull themselves out of poverty. They often lack proper market access to get a fair price for their produce because of their small marketable surplus and limited bargaining power. In addition, restriction on sale of produce outside regulated market yards limits market access further. A lot of effort is being put in by the government to link smallholder farmers with markets. However there are critical gaps existing in the present system since the producers are not in a position to get the reasonable value for their produce. Understanding smallholder farmers' functional range and formality of participation can be useful in understanding opportunities for upgrading and a stepping-stone to high value market strategies. Thus, there is a need to analyse four aspects of supply chain to make sound decisions or policies that can unlock poverty cycle.

First, to assess the characteristics of actors, profit and cost structures, flow of products throughout the market channel, employment characteristics and the destination and volumes of domestic sales. This will permit to reveal if smallholder farmers have access to modern markets such as supermarkets, wholesalers and processors.This necessitates validation of alternative market channels that are compatible with smallholder production and marketing strategies and offer great prospects of development. This validation can only be achieved through in-depth understanding of supply chains in the country. In addition, this will enable to develop a good empirical understanding on patterns of smallholder farmers; participation

in different supply chains, particularly there is need to establish whether smallholder farmers make discrete or multiple market channel choices.

Secondly, to identify the distribution of net economic benefits among actors in the chain to determine who benefits from participation in the chain and which actors could benefit from increased support. This is important in the context of Zimbabwe as a developing country given concerns that the poor in particular are vulnerable to the process. This enables to unveil if rural smallholders are prey to extortion by oligopsonistic behaviour among traders and processors who colluded to keep prices low. Non-competitive and predatory marketing practices by private traders can worsen smallholder farmers' plight by expelling them from high value chains.

Third, to examine the role of upgrading within the chain which involves improvements in quality in the product lines served, allowing producers to gain higher value. An analysis of the upgrading process includes an assessment of the profitability of actors within the value chain as well as information on limitations that are currently present.

Finally, to examine institutional innovations as a way of determining if they are promoting inclusion or exclusion of smallholder farmers in high value markets. There is need for institutional innovations as a key to achieving not only agriculture growth, by overcoming market failures, but also to ensure that poor smallholder farmers also benefit from the process through participating in high value markets. Getting institutions right is now widely accepted as a prerequisite for stimulating agricultural development in Africa (Kirsten and Vink, 2005). Commercial rules that govern commercial relationships in local value chains may constrain or restrict the role of the smallholder farmers, but also may create important learning and upgrading opportunities. External governance is important from a policy perspective by identifying the institutional arrangements that may need to be targeted to improve capabilities in the supply-chain, remedy distributional distortions, and increase value-added in the chain by smallholder farmers. This is achieved through fine tuning the coordination in the supply chain by farmers and other stakeholders.

Smallholder farmers need to be linked in a way that increases prospects of recovering from poverty. It is essential to measure the current market performance since it allows for tracking

and tracing of efficacy and efficiency failures and leads to more informed decision making with regard to chain design. This enables to establish and improve channel that offers great prospects for the development of smallholder farmers by identify specifically targeted interventions.

1.3 Objectives of the study

The major objective of the study is to evaluate economic performance of the domestic tomato supply chain and appraise economic benefits realised by smallholder farmers from the current market arrangement.

The specific objectives of the study are to:

a. identify the tomato supply chains
b. analyse the price behaviour of tomato
c. assess the economic performance of the major supply chains
d. evaluate the institutional innovations in the supply chains and
e. suggest viable supply chain options for smallholder tomato farmers in Zimbabwe

1.4 Study Rationale

It is crucial to understand the best practices for connecting small-scale producers to dynamic markets and bring these findings into the wider policy arena. The focus of the research is on the markets which are accessible to smallholder farmers in fresh produce supply chains, the net economic effects of these accessible markets on small-scale farmers and implications for local rural economies including local labourers. The major output of this research work will be to come up with empirical evidence on the nature of arrangements in the agricultural supply chains. The output of this research will be part of sets of tools which can be used by academics, agribusiness, development practionners, policy makers and other stakeholders to enable successful and sustainable integration of smallholder farmers into mainstream agricultural supply chains to improve their economic benefits. The study seeks to add knowledge on how to develop viable and compatible marketing strategies for smallholder farmers. The study explores challenges and opportunities faced by smallholder farmers in agricultural supply chains and how different development actors (Government, Agribusiness and farmer organisations) can leverage smallholder farmers' position in agricultural markets.

There is an urgent need to fill the gap in knowledge regarding the implications and opportunities for small-scale producers and with regards to restructuring of the food industry.

1.5 Limitations of the study

Unequal distribution of farmers to chains can lead to a biased technical efficiency results (Staat, 2001, Zhang and Bartels, 1998). In addition, sample size was perceived to be small which can affect the results. Generally, the smaller the sample size, the higher the efficiency score which can send wrong signals to policy makers.

1.6 Study organisation

The final output of this study is organised into an academic thesis, which contains five chapters. The first chapter gives introduction, problem statement and the research objectives including the study rationale. The second chapter presents literature review on the nature of agricultural supply, market integration and economic performance of supply chain. The third chapter states the research methodology (includes research paradigm and methods), which will be used to operationalise the study. Chapter four presents results and discussion. Chapter five gives a summary and conclusion of the major findings and policy recommendations including future research areas.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The purpose of this chapter is to give an insight into the theoretical background and related studies. It gives insights on key emerging findings and gaps existing from previous studies and related assessments. The chapter critically reviews literature on market access by smallholder farmers. The first section of the chapter gives important definitions of common concepts used in agricultural marketing and reviews literature on past studies on price behaviour, supply chain performance and institutions.

2.1 Smallholder farmer

The term smallholder is often defined and used in an inconsistent manner, referring, inter alia, to producers who occasionally sell products for cash as a supplement to other sources of income; to those who regularly market a surplus after their consumption needs have been met; and to those who are small-scale commercial farmers, with a primary focus on production for the market. Two criteria (often implicit, sometimes explicit) tend to predominate: size of land holding and extent of production for the market. Other possible criteria such as the use of different types of labour e.g. household or family labour, hired workers or co-operative labour, or source of farming capital, are occasionally mentioned but rarely discussed. Smallholders' are often characterized as forming part of the rural poor, together with subsistence producers and landless households. The emphasis is often on commonalities rather than differences e.g. in assets, income, investment and class identity.

The World Bank (2003) defines smallholders as those with a low asset base, operating less than 2 hectares of cropland. Dixon *et al.* (2003) define smallholders as farmers with limited resource endowments, relative to other farmers in the sector. Thus, the definition of smallholder farmers differs between countries and between agro-ecological zones. In favourable areas with high population they often cultivate less than one hectare of dry land, whereas they may cultivate 3-8 hectares in highveld or manage average of five head of livestock.

The smallholder sector in Zimbabwe is made up of three sub-sectors, namely small-scale commercial farms, resettlements areas and communal lands. The size of small-scale farms

varies usually between 1-5 hectares depending on the land tenure system in question (Turner and Chivinge, 1999). In this study, smallholders have been defined as those with a low asset base, operating equal or less than 5 hectares of crop land.

Smallholder producers often live in remote areas, far from good roads and markets. Rainfall may be erratic, poor soils and crops readily attacked by pests and diseases. Irianto and Harwanto (2009) identify the key problems as the lack of infrastructure, technical information, lack of finance and social problems. Murray-Prior (2007) identifies how poverty, high levels of illiteracy, ill health, low social and political status make it difficult for smallholder producers to embrace the changes required for them to compete in institutional markets that require high levels of management skills, sophisticated production technologies and economies of scale. Riisgaard *et al.* (2008) identify the lack of market information, an inability to meet the quality standards demanded by the market, limited access to resources and knowledge of their end consumers as the major constraints limiting smallholder farmers' access to institutional markets. Not only do most smallholder farmers lack the business skills, market knowledge, and political empowerment that might otherwise enable them to overcome many of the institutional impediments, most smallholder producers have too few assets to withstand the effects of price fluctuations and opportunism, price cuts and the cancellation of orders (Riisgaard *et al., 2008*). Their asset base is generally insufficient to meet the volume, consistency, year-round availability of downstream customers and to accommodate the long delays often associated with payment.

Irianto and Harwanto (2009) illustrated the importance of both technical assistance and credit in linking smallholder farmers to modern supply chains. However, while technical assistance and credit are important inputs for smallholder farmers to improve their production capacity, channelling credit into downstream market intermediaries may also have a positive effect, provided that the market intermediaries do not behave opportunistically. They demonstrated how those farmers who received technical assistance and a loan of PhP 8,000 to purchase seeds, fertilizers, pesticides and labour were able to generate profits when their produce was sold to supermarkets.

Kasarjyan (2011) described how, with the collapse of the Soviet Union, the lack of sufficient collateral precluded many smallholder farmers and food producers in Armenia from

accessing credit. The lack of capital negatively affected farm productivity and product quality which limited the export potential and the subsequent development of efficient and responsive agricultural supply chains. Kasarjyan (2011) also illustrated how, with only a modest capital investment, smallholder food manufacturers in Lumajang Regency, Indonesia, are able to process and market deep-fried banana chips. Processing not only produces a more marketable consumer product with a greater shelf life, but it substantially increases the income for smallholder producers. With an input cost of between Rp 3190 to 6250 to purchase the fruit, the final product is sold for Rp 16,000 to Rp 22,000 per kilogram.

In describing mango supply chains, Batt (2009) illustrated how farmers were completely unaware of the way in which they harvested and handled the fruit impacts upon downstream market intermediaries' and consumers' satisfaction with their product. At the farm level, the indicators used by farmers to determine fruit maturity were many and varied. Trees were either strip-picked or harvested 3 to 4 times at intervals of 7 to 15 days. Fruit that was too hard to reach was often left on the tree until it fell naturally, but when prices were high, fruit was often harvested immature.

2.2 Market as a concept

The diversity and ambiguity of the notion of a market in common manner of speaking corresponds with few and rather diverse attempts to define the notion in more detail. According to Eckehard (2000) generally there are three categories of definitions namely observational definitions, functional definitions and structural definitions.

The observational definitions comprise definitions, which refer to some empirical phenomenon, often together with one or several stylized facts about prices or commodities. They saw the market as synonymous with either a marketplace or a geographical area in which exchanges of the same commodity take place (Swedberg, 1994). Thus, a market is a region in which buyers and sellers are in such frequent intercourse with each other that the prices of the same goods tend to equality easily and quickly (Eckehard, 2000). Lipsey (1983) defined a market as 'an area over which buyers and sellers negotiate the exchange of a well-defined commodity. His definition thus echoes the traditional notion of a marketplace, even though the area in question is now (apparently) much larger than a medieval square or the site

of a trade fair. Moreover, his definition also highlights the notion of a well-defined rather than unspecified commodity.

In contrast to observational definitions, functional definitions focus on what the market does rather on what, from an empirical point of view, the market is. The market is essentially regarded as an allocation mechanism or the concept of a market is equated with the determination of relative prices by demand and supply (Barnett, 1991). The definition reflects the analytical role ascribed to the market in orthodox economic theory.

The last category comprises structural definitions. These definitions draw attention the underlying and hence not immediately observable structure of a market, emphasising the alleged mechanisms and structures that give rise to market phenomena. Hodgson (1988 quoted in Eckehard, 2000)'s definition, for instance, belongs to this category, for he saw the market as a set of social institutions in which a large number of commodity exchanges of a specific type regularly take place, and to some extent are facilitated and structured by those institutions. Exchange involves contractual agreements and the exchange of property rights, and the market consists in part of mechanisms to structure, organize, and legitimate these activities. According to Swedberg (1994) a market refers to a group or groups of people, some of whom desire to obtain certain things, and some of whom are in a position to supply what the others want.

Bearing these limitations at hand, the above categorization nevertheless suggests that definitions are friendly to specific purposes, which can be rationalised against the background of the research program within which they are introduced. This study defines a market as an arrangement, whereby buyers and sellers come in contact with each other directly or indirectly, to buy or sell goods. Thus, the definition statement indicates that face to face contact of buyer and seller is not necessary for market. For example e-marketing buyer and seller can carry on their transactions through internet. So internet, here forms an arrangement and such arrangement also is included in the market.

Market access is one of the most critical linkages in farming business for the rural farm households making it a prerequisite for enhancing agriculture-based economic growth and

increasing rural incomes. In this study market access is when the farmers get inputs/service in the input or services market or supply their produce to a particular group of consumers.

2.2.1 Agricultural price behaviour

Prices perform a number of functions in an economic system. According to Mellor (1978), the three main functions of agricultural prices are to serve as an allocator of resources, signalling to both producers and consumers regarding the level of agricultural production and consumption, a distributor of income and influence on capital formation. In a competitive economy, the pricing mechanism provides the signals to the producers in deciding what and how much has to be produced with the available resources for maximization of welfare. A particular movement of agricultural prices may facilitate the achievement of certain goals, while the same movement may operate against some other goal. For example, a steep rise in the price of food grains may fulfil the goal of remunerative price to the farmers but it might adversely affect the standard of living of agricultural labourers, other wage earners and non-farm consumers who buy the food grains. Therefore, a continuous watch on prices is necessary in all societies.

Price changes constitute one of the elements contributing to the risk of farming. They change from year to year, from month to month, and from day to day. Some of them change from hour to hour, and even from minute to minute. Prices of raw agricultural products rise and fall more, faster and sooner than prices received for processed goods and services. The same is true of farm prices as compared with wholesale and retail prices of farm-derived products. As a result, the farmer experiences difficulty in planning production to cope with price changes. Agricultural price movements are caused by different forces according to the length of time involved. Long-time movements, for example, are caused by changes in population, in the technology of production, in real income per capita, etc. These forces are slow to move. Short-time movements are caused by different forces such as annual variations in weather, wars, booms, and depressions. Still shorter movements are caused by still other forces. Farm prices have four important movements: long-run trend, seasonal variation, cyclical movements, and irregular fluctuations. Since a farmer can adjust his operation in some degree to take advantage of seasonal variation, primarily this price movement is considered in this study.

2.2.2 Agricultural price seasonal variation

Seasonality is frequently mentioned as a major aspect of price variation for many agricultural commodities. Market analysts refer to seasonal price patterns as they present market outlooks and advice for producer marketing strategies. Manternach (2009) has defined seasonality as the tendency for the highest prices of any given year to happen at certain times of the year and the lowest prices of any given year to happen at certain times of the year. Thus, seasonal variations are patterns of change in a time series within a year and the patterns tend to repeat themselves each year. In this study seasonality refers to recurring variations of a value at certain periods (month, quarter, etc.) of the year.

Seasonal index can help identify seasonal patterns. A seasonal index is how much the variable under study (e.g price) for that particular period tends to be above or below the average price. The average seasonal variation, independent of other kinds of variation such as irregular year-to-year, cyclic and secular, can be measured by any one of several different methods. The simplest method is to assemble the monthly data over a fairly long period and compute the average for each month separately. The averaging process eliminates most of the non-seasonal variation. A more complicated method is to use link relatives; this is a laborious procedure, and the results usually are not much different from those obtained by the simple averaging process (Shepherd, 1950). The seasonal index can be calculated as the ratio of the average value in a season (month, quarter, etc.) to the overall annual average value. The variation or departure in individual years from the average seasonal variation can be measured by computing the average deviation of the percentage of trend for individual months about the value of the index of average seasonal variation for each month. This may be called the index of irregularity. A band of the size of this index on both sides of the index of average seasonal variation may then be plotted on a chart to show both the index of seasonal variation and the index of irregularity.

Mehta and Pankaj (2000) analyzed the seasonality in prices of groundnut and maize. The results showed linear trend in maize prices. The oscillatory movements affecting the prices are regular in period and amplitude. There existed a crop production periodicity of 12 months seasonality. Seasonality index ranged between 5.0-5.9 implying that its supply and consumption was nearly equi- spread throughout the year. Steep price fall after September synchronized with crop attaining maturity in three months after sowing. In case of groundnut,

the results showed moderately increasing trend, the periodic variations were of non-uniform cycle and amplitude.

Wadhwani and Bhogal (2003) observed price behaviour of cauliflower and cabbage in western Uttar Pradesh (1988-1997). The results showed that, the prices of these two vegetables were found maximum in the month of September and started declining from October onwards. The prices were again found increasing from the month of May. The lowest prices were indicated in the month of March and also prices of cauliflower/cabbage responded negatively to the arrivals.

Dawson and Dey (2002) studied spatial market integration among major rice markets in Bangladesh. An integrated empirical framework tested long-run spatial market integration between price pairs using a dynamic vector autoregressive model and cointegration. Hypotheses tests of market integration, perfect market integration, and causality were conducted sequentially using monthly prices from rice markets in Bangladesh after the move for trade liberalization in 1992. Results revealed that rice markets in Bangladesh were perfectly integrated with each other. The research findings of the causality analysis showed that Dhaka market dominated the nearby markets but was itself dominated by more distant markets.

Navadkar *et al.* (2005) in their study on seasonal indices of monthly arrivals and prices of vegetables in Pune (1990-2000) observed lowest coefficient of variation of arrivals for tomato. The price was highest during the month of March and below 50 per cent during April to June. In case of Bhindi, the coefficient of variation of arrivals was far below 50 per cent for the period from April to October, while it was more than 50 per cent in all the months except in November and May. It was noticed that the coefficient of variation ranged from 22-79 per cent and for prices was ranging from 31to 69 per cent for cabbage. It was indicated that when the arrivals of vegetables were at the pick, the lowest prices were recorded.

Khunt *et al.* (2006) analyzed the seasonal indices of potato in Ahmedabad during 1981-2000. The results of the study indicated that the highest index of arrivals was observed in the month of March. The price index of potato was lowest in the month of March when the

corresponding arrival was highest. The price index was below average from January to May and above average from June to December. The reason was the pattern of market arrivals.

Mitrannavar and Gummagolmath (1998) attempted to analyze the seasonal indices of arrivals and prices of potato in regulated markets of north Karnataka. The long run trends in arrivals and prices of potato for the selected Belguam and Hubli markets were analyzed using three years moving average method. The study concluded that arrivals were highest in the month of November in both the markets indicating glut during harvesting season. However, price did not decrease during glut season as the majority of the traders purchased potato at that time in Belguam market while there was a negative relationship between arrivals and prices in Hubli market.

Nahatkar *et al.* (1998) revealed that seasonal index of cotton prices was minimum in the second quarter (January to March) and maximum in the third quarter (April to June). The coefficient of price variation showed that price rise was higher during first quarter (October to December), as buyers tend to attract more cotton growers to sell their produce at lower prices. The data on cyclical variations showed that after every three years the cycle of cotton prices changed irrespective of the variations in price in the three quarterly periods revealing that within a year there was no sudden short fall or boom of cotton arrivals in the market. The variation in arrivals of cotton was found to be higher than that of variations in prices.

Hofstrand (2012) based on monthly profitability estimated seasonal variation in the profitability of corn ethanol production. Analyzing monthly data from 2004 through 2011, profits during the last half of the year appeared to be higher than those during the first half of the year. Average profits were lowest during February through April and then began to increase, reaching a high in July. Profits remained above average during most of the remainder of the year before dropping below average in December.

Jadhav *et al.* (2011) examined seasonal variation in arrivals and prices of selected agricultural commodities. The study was based on the secondary data on arrival and prices of soybean in A.P.M.C., Achalpur, Amravati, Morshi and Daryapur for the period of 10 years i.e. from 1999-00 up to 2008-09. The results indicated that amongst all selected markets, arrival and price index were observed to increase in case of soybean compared to the base year. In all

selected markets, monthly seasonal index of soybean was found to be the highest immediately after harvest. Whereas price index of soybean was found to be lower during peak arrival months and vice versa. The current study employs seasonal index to assess seasonal variation in tomato markets.

A study by Sani and Farahani (2011) determined seasonal prices variations in some food crops. The study was carried out at Karaj city of Iran. In their study four groups of food products were used. The first group comprised tree fruits (orange, apple and pomegranate), the second was composed of the kitchen garden fruits (watermelon, melon and cantaloupe), the third included greenhouse fruits (banana, strawberry and pineapple) and the fourth group was constituted by vegetables (tomato, potato and onion). Each of the above products price was determined in each season (spring, summer, autumn and winter) and were compared with one another by statistical graphs. The results showed that price variations were high in tree fruits, vegetables and kitchen garden fruits than the greenhouse fruits and demand of these products was very dependent on price variations. The results showed that the greenhouses production and processing food products can keep constant prices of food products throughout the year and remove the destructive role of brokers. The current study uses time series analysis to determine seasonal variation in place of descriptive which was used by Sani and Farahani (2011). The ratio to moving average analysis yields better results than descriptive analysis.

Stark and Bryant (2010) conducted a study on seasonal price patterns for Arkansas Soybeans in United States of America (USA). Monthly average soybean prices for Arkansas from September 1999 to August 2009 were used in the study. Prices ranged from $4.23/bu. to $14.54/bu during this time period. They computed seasonal indices. The results revealed that Arkansas soybean prices appeared to have followed a consistent and logical pattern around their annual average in recent years, in spite of increased variability and uncertainty in the overall U.S. grains markets. The range of soybean prices in a season was greater than it was in the 1970s and 80s. The months of August and September had especially experienced variability in soybean prices relative to the yearly average price. The study at hand adopts the concept of seasonal indices but using weekly data instead of monthly data as period (weekly, monthly or quarterly) is determined by availability of data and nature of crop.

2.2.3 Market integration and price transmission

Studies on the transmission of price signals are founded on concepts related to competitive pricing behaviour. In spatial terms, the classical paradigm of the *Law of One Price*, as well as the predictions on market integration provided by the standard spatial price determination models postulate that price transmission is complete with equilibrium prices of a commodity sold on competitive foreign and domestic markets differing only by transfer costs, when converted to a common currency (Takayama and Judge, 1972). These models predict that changes in supply and demand conditions in one market will affect trade and therefore prices in the other markets as equilibrium is restored through spatial arbitrage. Price transmission studies are ostensibly an empirical exercise testing the predictions of economic theory and providing important insights as to how changes in one market are transmitted to another, thus reflecting the extent of market integration, as well as the extent to which markets function efficiently. In these models the price transmission parameter values consist of key building blocks and play an important role in determining the direction, magnitude and distribution of welfare effects of trade policy scenarios (Sharma, 2002).

The absence of market integration or of complete pass-through of price changes from one market to another has important implications for economic welfare. Incomplete price transmission arising either due to trade and other policies or due to transaction costs such as poor transport and communication infrastructure, results in a reduction in the price information available to economic agents and consequently may lead to decisions that contribute to inefficient outcomes. Agricultural and food trade policy reform, especially, is a priority issue as trade liberalization is viewed as encouraging allocative efficiency and long run growth.

The large body of research on market integration and price transmission, both spatially and vertically, has applied different quantitative techniques and has highlighted several factors that impede the pass-through of price signals. Distortions introduced by governments in the form of policies either at the border, or as price support mechanisms weaken the link between the international and domestic markets. Agricultural policy instruments such as import tariffs, tariff rate quotas, and export subsidies or taxes, intervention mechanisms, as well as exchange rate policies insulate the domestic markets and hinder the full transmission of international

price signals by affecting the excess demand or supply schedules of domestic commodity markets (Baffes and Ajwad, 2001; Abdulai, 2000; Sharma, 2002).

Apart from policies, domestic markets can also be partly insulated by large marketing margins that arise due to high transfer costs. Especially in developing countries, poor infrastructure, transport and communication services give rise to large marketing margins due to high costs of delivering the locally produced commodity to the domestic market for consumption. High transfer costs and marketing margins hinder the transmission of price signals, as they may prohibit arbitrage (Badiane and Shively, 1998). As a consequence, changes in market prices are not fully transmitted to the other market prices, resulting in economic agents adjusting partly to shifts in world supply and demand.

Most of the studies utilize time series econometric analysis techniques that test for the co-movement of prices. The development of these techniques, which include cointegration and error correction models, has become the standard tool for analysing spatial market relationships, replacing earlier empirical tools, such as the bivariate correlation coefficient and regressions. Nevertheless, time series analysis has also being criticized as unreliable with recent research focusing on switching regime models that incorporate data on prices, volumes traded and transactions costs (Blauch, 1997; Barrett and Li, 2002). In essence, linear tests for market integration and price transmission are thought of as crude and inappropriate (Blauch, 1997 and Barrett and Li, 2002). Non linearities in market relationships that arise from arbitrage conditions, unsynchronized price cycles, discontinuous trade and non stationary transfer costs are thought of as rendering linear representations and models not useful and inaccurate.

In this study, although there is some merit in the above criticisms, especially as far as non stationary transfer costs are concerned, time series analysis is perceived to provide useful insights into the issue of market integration and price transmission if an appropriate testing framework is employed and the results are interpreted correctly. Cointegration and error correction models provide an analytical tool that can focus beyond the case of market integration or complete price transmission, in testing notions such as completeness, speed, and asymmetry of the relationship between prices.

Time series models have small data requirements as compared to other methodologies, relying on price series only, which are more easily available for developing countries. In addition, time series applications perform a useful role in signalling potential failures in markets and in contributing to the assessment of the direction, magnitude and distribution of welfare effects of trade policy reforms. However, it is important to note that, in general, time series applications may also founder while attempting to achieve an unattainable goal, which of giving a universal measure of the extent of price transmission in terms of a single parameter or test.

Since the influential work of Engle and Granger (1987), cointegration has emerged as a powerful technique for investigating common trends in multivariate time series, providing a sound methodology for modelling both long run and short run dynamics in a system. The interest in cointegration literature has increased significantly as a result of this work and has given rise to other important contributions to the subject.

Ghosh *et al.* (1999) purports that financial theory hypothesizes that in the long run, certain pairs of financial time-series data are projected to move together. Ghosh *et al.* (1999) also claim that short run deviations will be brought back to equilibrium due to investors tastes and preferences, market forces and government regulations. However, it is the understanding of how these short-term movements are related to each other that will help to understand the economic relationships between the markets in this study more completely.

Barrett (2001) and Barrett and Li (2002) distinguish between market integration and the efficiency. They pointed out that tradability and nonzero trade flows is a sufficient condition establish market integration, whilst efficiency is established when prices in two different markets differ by transfer costs. In this study, the traditional definition of market integration that adheres to the satisfaction of the Law of One Price and to the equilibrium conditions of the Enke-Samuelson-Takayama-Judge model. The study at hand postulates that tradability on its own is not sufficient to ensure the integration of economic agents in the market process.

Goodwin and Schroeder (1991) evaluated spatial linkages in regional cattle markets using co-integration tests. The results revealed that several markets were not cointegrated over the period 1980 through 1987. However, significant increases in co-integration of several

regional livestock markets were observed through the 1980s. The increased cointegration parallels significant structural changes in the livestock industry

Baharumshah and Habibullah (1994) employed the cointegration method developed by Engle-Granger to analyse the long-run relationship between pepper prices in different markets in Malaysia. The results indicated that regional pepper markets in Malaysia were highly cointegrated which implied that commodity arbitrage was working. The results also showed that the prices of pepper moved uniformly across spatial markets. Importantly, the distance between markets was not an impediment to efficient adjustment of price to new information. Thus the price changes were fully and immediately passed on to the other markets.

Allen and MacDonald (1995) analysed the benefits of international diversification to Australian investors, using monthly index data for 16 countries. Both the Engle-Granger and Johansen cointegration tests were used to measure these diversification benefits. As was the case in other selected studies such as Taylor and Tonks (1989) and Allen and MacDonald (1995) found that different cointegration testing methods yielded different results in certain cases. Also, evidence of cointegration between the analysed data subsets was found, indicating that there is little benefit to the investor by diversifying internationally. Taylor and Tonks (1989) studied the impact of abolition of U.K. exchange controls, and the effect of this on the integration of U.K. and overseas stock markets. They concluded that there appears to be no long-run gain from diversification owing to the apparent increase in the degree to which markets move together. This study is close to current study as it employs Johansen integration.

Behura and Pradhan, (1998) used bivariate price series correlation and Engle-Granger test to analyze the market integration in the Marine fish markets in Orissa. The bivariate correlation coefficient for six selected market pairs ranged between 0.6 and 0.85. The cointegration test statistic revealed that all the pair wise markets were found to be less than the asymptotic critical value even at 10 per cent level. Therefore the marine fish markets in Orissa were found to be not integrated which was attributed to poor infrastructural facilities at landing centers as well as at the terminal secondary markets. Thus poor market integration observed

in Orissa revealed that marine fish markets were quite uncompetitive which necessitated strong and extensive government intervention to enhance market efficiency.

Ghosh, (2000) investigated intra-state and inter-state spatial integration of rice markets in India and found that the Indian rice markets were spatially linked in the long run. Even though the regional markets were geographically dispersed, spatial pricing relationships indicated that the prices were linked together and hence all exchange locations were in the same economic market.

Mahesh *et al.* (2000) studied the relationship between domestic (Kolkata) and international (London) market prices series of tea using the co integration analysis. The results revealed that the tendency of the price series of both domestic and international market for tea move in-unison in the long-run confirming the law of one price (LOP).

Dawson and Dey (2002) studied spatial market integration among major rice markets in Bangladesh. An integrated empirical framework tested long-run spatial market integration between price pairs using a dynamic vector autoregressive model and cointegration. Hypotheses tests of market integration, perfect market integration, and causality were conducted sequentially using monthly prices from rice markets in Bangladesh after the move for trade liberalization in 1992. Results revealed that rice markets in Bangladesh were perfectly integrated with each other. The research findings of the causality analysis showed that Dhaka market dominated the nearby markets but was itself dominated by more distant markets.

Bessler and Yang (2003) conducted a study into the dynamic structure of nine major stock markets (Australia, Japan, Hong Kong, UK, Germany, France, Switzerland, USA and Canada) using Johansen's maximum-likelihood model, and found only one cointegration vector. They infer that the US market is the only stock market that has a long-term contribution to the price levels in other markets.

Jyotish and Dinda (2003) observed that the highest values of 'r' for wholesale as well as retail price have been found strongly correlated. It was found that the test statistic obtained from all the pair-wise markets were seen to be greater than the critical value at one per cent level of

significance. All the market pairs in Hooghly district in terms of both wholesale and retail price were shown to be co-integrated. So, this was mainly attributed to close proximity, good communication facilities and good infrastructure availabilities among the market centre in Hooghly district. The high degree of market integration shows that potato markets in the states are competitive and efficient at the wholesale level.

Luz and Thilmany (2003) examined fresh tomato price relationships between two major North American shipping points (Sinaloa, and Florida) and several major terminal markets in the U.S. and Mexico to infer whether business strategies vary by supply region or the geography of consumer markets. The results showed some evidence of inefficient pricing behaviour among some markets, and suggest that Mexican shipping point prices were less integrated with Mexico's own terminal markets than the closest U.S. market, Los Angeles. Moreover, perfectly competitive price behaviour was less likely in a terminal market (Chicago) where Sinaloa and Florida compete during winter months.

Another study closely related to current study is Yang *et al.* (2003)'s analysis of cointegration between US and international stock markets over a 32 year sample period. Yang *et al.* (2003)'s finding was that there was no long-run pattern of cointegration. They do see an increase of cointegration in the latter part of their sample period, but conclude that due to the weak cointegration overall, there is diversification of benefits to US investors from splitting their equity portfolio between the countries studied. These results are based on analysis of the larger markets including Japan, United Kingdom, and Germany. They did however find an increasing integration between the US and many smaller markets. Their data consisted of time-series from 1970 to 2001. Current study's data span from 2011 to 2013and focuses on fresh tomato markets.

Conforti (2004) recorded that price transmission among markets was affected by factors like transportation and transaction costs, market power, increasing returns to scale in production, exchange rate and border and domestic policies. Transportation costs caused relative prices of two qualities of the product to differ across regions by an amount unrelated to the original prices. Transportation cost acted as a wedge between different markets, which needed to be overcome by the total price differences between two locations or industries to allow for arbitrage and integration to take place between different markets. This treatment could be

assumed stationary that might be proportional to traded quantities rather than fixed in nature. Along the production chain, some agents behaved as price makers while others as price takers, depending on the degree of concentration of each industry. Testing for price transmission could be interpreted as an exercise to check the degree of efficiency of the markets, in terms of extent of congruence with competitive models or as a test for market integration. In India, within the domestic markets, price transmission appeared to be fairly complete between the wholesale and the retail prices.

Hau and Oppen (2004) estimated market efficiency of fruits and vegetables in Northern Thailand. They tested the hypothesis that fruits and vegetable crops were diverse in market efficiency mainly due to characteristics of the markets (i.e. market size), location of markets (i.e. income structure) and distance between markets. Average weekly prices for mangoes, leeches, cabbage and carrots were collected for the year 2001 at one wholesale and ten retail markets in and outside Chiang Mai City. In addition to prices, weekly Chiang Mai farm-gate prices and Bangkok wholesale prices were collected for the same period from the Office of Agricultural Economics and Talat Thai Market respectively. Quantitative and qualitative information ware collected by interviewing 32 vendors, 30 traders and 11 market owners/ administrators. Pearson correlation coefficients were used to analyze market efficiency by measuring the pricing efficiency and degree of integration between markets. In addition, qualitative and quantitative data obtained from traders and market managers were included in the analysis to determine the factors affecting market efficiency. The results showed that market size and income structure had significant impact on market prices. However, impact of distance between markets on pricing showed mixed results. Correlation between various markets for cabbage was observed as against for carrots, leeches and mangoes where no correlation was recorded.

McLaughten (2004) in the study of the dynamics of fresh fruits and vegetable pricing in the super market channel, it concluded that major factor that contribute to the complicated price formation process at several levels of fruit and vegetables in the US were marketing channels, market structure changes, pricing techniques and promotional impacts, retail responses to supply changes, and price versus value.

Kumar *et al.* (2005) conducted a study with twin objectives of examining the variability pattern of market arrivals and prices of selected vegetable crops (cabbage, cauliflower, tomato and peas) in metropolitan markets of Delhi, Mumbai, Bangalore and Kolkata and analysing the relationship between market arrivals and prices. The study was based on market arrivals and wholesale prices of different vegetable crops collected from the Azadpur market of Delhi and Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi, for the period from 1990 to 2001. The Karl Pearson correlation coefficient was computed to find the degree of relationship between market arrivals and prices. The study had shown that the extent of variability in the arrivals of cabbage was lower in Bangalore and higher in Mumbai. The study established that the prices were relatively stable in Mumbai but more volatile in Bangalore. There was broadly a similar pattern in the price variability across different months in Kolkata and Delhi markets. For cauliflower, the variability in the market arrivals was more pronounced in Kolkata than the remaining three markets. The price variability was, however, more marked in Delhi. The extent of variability in the market arrivals of tomato across different months was very high in all the four markets.

The objective of the study by Vavra and Goodwin (2005) was to introduce the subject and mechanisms of asymmetric price transmission, and to discuss a relatively new procedure that measures price transmission empirically. The focus was on vertical price transmission, *i.e.* along the supply chain, and the possible types of adjustments to a price shock are discussed. In particular, it was noted that vertical price adjustments can be characterised by the speed, direction and magnitude relative to the initial market shock, with the results in each case being determined by the underlying relationships among agents at different levels of activity.

Kasibhatla *et al.* (2006) studied cointegration between major West European stock markets (CAC40, DAX30, and FTSE100). Their findings supported the notion that there is cointegration between the markets and identified the CAC40 as being weakly exogenous as there can be excess returns in the short term by diversifying internationally. Kasibhatla *et al.* (2006) employed the Johansen Cointegration Methodology mainly because they found it was the most common method used to study long-term cointegration relationships along with their references to support this claim.

Maneschiold (2006) analyzed cointegration between Baltic stock markets and major international stock markets, including UK, France, Germany, US and Japan. The cointegration analysis indicated that German markets dominate the long-term relationship with Baltic stock markets. Furthermore, the overall results suggest that international investors can obtain a long term benefit from diversification due to the absence of cointegration of Baltic and international capital markets. This study concentrated more on the emerging Baltic Markets and their movements compared to the major international markets using cointegration, whereas current study focuses on the agricultural fresh produce markets, incorporating weekly data over the past 2.5 years.

Chebbi and Lachaal (2007) in their study on agriculture sector and economic growth in Tunisia using time series cointegration techniques indicated that in the long-run all econometric sectors tend to move together (co-integration). But, in the short-run, the agricultural sector seems to have a limited role as a driving force for the growth of the other sectors of the economy. In addition, growth of the agricultural output may not be conducive directly to non-agricultural economic sector in the short-run.

Onay (2007) suggests that there are long-term diversification opportunities in Bulgaria and Romania due to the lack of cointegration with the European Union. This study is concentrated around the accession negotiations with the EU, and demonstrates the fact that diversification benefits are negatively related to the underlying level of cointegration between markets. Onay highlights the possible benefits of investing in those countries that are new entrants or prospective entrants to the EU, due to their lack of cointegration with developed markets, supporting possible effects of the European Union on cointegration.

Sedaghat (2007) evaluated the spatial price integration of Iran's pistachio prices with USA prices as a major rival country of Iran in world market. The study used time series data on domestic and export prices collected for the time periods 1982-2003 and 1991-2004 respectively. The price series used for comparison were Iran's producer and export prices, Iran and USA export prices and Iran and USA producer prices. Co-integration analysis and Dickey-Fuller test were employed. Results reveal that none of the price series are co-integrated. This shows that the LOP cannot be hold, and so the prices are not moving together in long run.

Fadhlaoui *et al.* (2008) analyzed the short and long-run relationships between seven developed equity markets (US, Canada, UK, France, Germany, Italy and Japan) with Czech-Republic, Hungary and Poland to evaluate evidence of cointegration. This was done to identify potential international diversification benefits. In the short-term, it was found that there was a lower level of cointegration between the aforementioned developed equity markets and those of Central Europe. This short-term analysis was performed using the correlation matrix, whereas the latter long-term analysis employed the use of the Johansen cointegration test. The Johansen test revealed no evidence of a long-term relationship (cointegration) between the two groups of markets. It can therefore be said that the increased financial integration between equity markets internationally has not detracted from the potential diversification benefits available to investors in this particular market.

Saran and Gangwar (2008) analysed the spatial cointegration amongst major wholesale egg markets in India through measurement of oneness in the egg markets for which, the Engle-Granger cointegration test procedure was applied to egg price series for major wholesale egg markets in the country. The study indicated that the major markets were cointegrated apparently due to performance of market intelligence functions by National Egg Coordination Committee (NECC) which helped in transmitting price signals across length and breadth of the country through print media on day-to-day basis. The high degree of cointegration amongst various markets indicated that the markets were competitive and efficient at the wholesale levels.

Vasisht *et al.* (2008) studied the price behaviour in fruits and vegetable markets using co-integration and error correction analysis techniques. The empirical results on the price behaviour provided evidence of high volatility in the prices of fruits and vegetables in major markets. There was a presence of long-run relationship across some of the state level markets for less perishable commodity like apple. The findings clearly indicated that the horticulture sector in India could thrive for greater benefit of both producers and consumers only if better infrastructural facilities like storage, modern marketing infrastructure, as well as timely availability of market information and better market intelligence are developed fast across all states.

Al (2009) evaluated price behaviour of rice to identify the farmers' perception on high rice price in past using year wise nominal market prices which were collected from different secondary sources. Forty five farmers were randomly selected for the study to measure their perception on high rice prices. The Compound Growth Model (CGR) and quadratic model were used to analyze the price behaviour. The results showed that year-wise nominal market prices (NMP) of all types of rice had been increasing continuously. However, the real market prices (RMP) of rice had been decreasing.

Amikuzuno and Ihle (2010) assessed market integration and price transmission of perishable agricultural produce in Sub-Saharan Africa. They analysed the tomato markets of Ghana by simultaneously regarding its five most important markets, Navrongo, Techiman, Kumasi, Tamale and Accra, in a multivariate asymmetric price transmission framework. The estimation of the model was based on a modified version of the Johansen estimation procedure which was suitable for estimating such multivariate models. The study estimated the price transmission parameters for four regimes which were a combination of the seasonal patterns in trade flows and asymmetries in the long-run price equilibrium between the most important production region and the most important consumption centre for tomatoes. It found that in general, price transmission appeared to be fast. Disequilibria mainly triggered price responses in the two production regions of Navrongo and Techiman. The regimes are found to matter for the whole system of tomato markets. Disequilibrium is shown to spill-over between the price relationships. Consequently, tomato markets in Ghana appeared to be integrated and function very well since price signals were rapidly passed through the country.

Adenegan and Adeoye (2011) examined the level of market integration in tomato markets in rural and urban markets of Oyo State, Nigeria. Secondary data on tomato price spanning *2003 –2010* were sourced from Oyo State Agricultural Development Programme (OYSADEP). The data were analyzed using Augmented Dicker Fuller (ADF) test. Indices of market concentration were also used to measure the degree of market integration. Results indicated that the maximum rural price of tomato was □131.74/kg in May, 2009 while the minimum price was □43.23/kg in August, 2004. In the urban areas, the maximum price was □132.13/kg in May, 2009 while the minimum price was □40.98/kg in September, 2004. The results also revealed that prices of tomato were stationary at their level. Urban tomato market does not granger cause rural tomato market ($P > 0.05$), while rural tomato market granger

cause urban tomato market (P< 0.05). None of the markets links exhibited bidirectional granger causality or simultaneous feedback relationship. The Index of market connection (IMC) indicated that the markets exhibited low short run market integration.

Ravinde (2011) examined the behaviour of market arrivals and prices of tomato and their nature of relationship in selected markets over the years. It has been found that both market arrivals as well as prices of tomato had shown increasing trends in all the markets during 1991 to 2003. The seasonality in prices of tomato was higher than the seasonality in market arrivals in all the selected markets emphasizing the improvement in the production and protection technologies and imperfection in markets and marketing system of tomato. The selected markets were also found not integrated as shown by the monthly price variations across the markets. The lagged price was an important factor in determining the current price than the market arrivals.

2.3 Performance of supply chain

Though many organizations are adopting supply chain management practices, what distinguish are those who succeed and those who fail. Most of SCM practices may take the organization to the higher level of performance, if all the SCM activities are measured and monitored. So it is evident that performance measurement is required for the success of supply chain management (SCM).

A supply chain is a network of organisations involved through upstream and downstream linkages, in the different processes and activities that produce superior value for the ultimate consumer (Cadilhon *et al.,* 2006). Value is the worth in monetary terms of the economic, technical, service, and social benefits a customer receives in exchange for the price that it pays (Anderson and Weitz, 1992). Value is achieved when the proper function is secured for the proper cost (Hutt and Speh, 1995). Buyers typically consider product and supplier attributes in a manner that seeks to minimize the various problems associated with purchase and use (Wilson, 1994). Simpson *et al.* (2002) described how suppliers had the potential to positively (or negatively) affect customer inventories, product quality, cost, and delivery times. As prudent supplier selection leads to improved buyer performance, price is becoming less important in the decision to purchase (Batt, 2006). Nevertheless, a supplier must be cost competitive even if it offers a superior quality product or more reliable delivery.

Linkages refer to the interdependency that exists between the actors and the activities that they perform (Ford *et al.*, 1998). As the output of one firm becomes the input for another, in food chains, each participant must understand how the quality of the product will deteriorate irrevocably at each stage of the supply chain with inappropriate handling (van der Vorst *et al.*, 2007; White, 2000).

The efficiency of a supply chain ultimately depends upon the efficiency of each individual actor and the linkages that have been established between them (Herlambang *et al.*, 2006; Humphrey, 2005). Effective supply chain management requires cutting costs, ensuring consistency from day to day, and raising product quality and diversity. Th is can be achieved by improving coordination and logistics systems, contracts with wholesalers and producers, and private standards which specify the quality, safety, volume, and product packaging (Reardon and Berdegue, 2002). As supply chains are complex systems with numerous activities spread over multiple organizations and often over lengthy time horizons, to improve performance, it is necessary to overlay a coordination system that brings these multiple functions and organizations together as a part of a unified system. However, if the benefits of successful coordination are to be achieved, four variables are considered crucial: trust, decision making, information sharing, and goal congruence (Lejeune and Yakova, 2005).

Morgan and Hunt (1994) described how participatory agricultural chain assessment (PACA) is used as a tool to facilitate a greater understanding of agricultural supply chains and the subsequent identification of appropriate intervention strategies. Developed by the Belgium-based NGO Vredeseilanden, the aim of PACA is to provide a means for smallholder farmers to more actively participate in the decisions that shape the structure and processes of the chain in which they are involved and to ensure that the benefits derived from their participation are commensurate with the activities they perform and the risks endured.

Poot *et al.* (2000) conducted the study on chain information to support Dutch supply chain effectiveness. The goal of the project was to collect information from distribution chain of Dutch horticultural products, in order to support chain effectiveness. They found that Dutch growers were able to produce high quality products, but that they had problems to supply large quantities, at uniform qualities at low prices with their method it was possible to get insight in price and future demands on horticultural products and on the services of their

suppliers. This information could be used by Dutch horticultural industry to develop customers driven production and distribution strategies.

Lee *et al.* (2001), concludes his research work on supply chain performance stating that a study is needed to develop a system that would suggest the detailed action plan to implement the best practices with respect to each managerial criterion in supply chain performance measurement.

In an empirical examination of the perceived differences in offer quality between Western Australian rock lobster exporters and their respective Japanese importers, Batt and Morooka (2003) revealed that Western Australian exporters needed to give greater consideration towards enhancing the value of their product offer by providing continuous product support, more timely market information, and responding better to importers immediate needs rather than to attempt to compete on price.

Building upon the concept of market orientation, Storer *et al.* (2003) proposed that the more a supplier understood the needs of its downstream customers, the better the firm would be able to meet the needs of the ultimate consumer.

A study by Cadilhon *et al.* (2006) focused on vegetable supply chains in Ho Chi Minh City comparing traditional and modern food systems. Data were collected from supply chain actors such as farmers, supermarkets and wholesalers. The study employed efficiency, market share and labour index to measure performance of supply chain. The results indicated that the chains as segmented in their product focus, the modern sector focused exclusively on quality. Modern supply chains were generally more efficient than traditional ones but accounted for only around 2 per cent of vegetable distribution. The article argued that policy-makers should not promote the modernisation of food systems at the expense of traditional channels which met important consumer needs.

Carlos and Alberto (2004) analyzed hypermarkets and supermarkets in Portugal to compare retail chains that compete in the same market. A two-stage procedure to benchmark the companies was adopted. In the first stage data envelopment analysis (DEA) was used and in the second stage a Tobit model was employed to estimate the efficient drivers. He found out

that, on an average, the efficiency of hypermarket and supermarket retail companies is high compared with that in other sectors and also that larger retail groups are more efficient than the smaller retailers. He also noted that national retailers are more efficient than regional retailers. He concluded that scale played an important role in this market and the efficiency drivers were market share, number of outlets and location.

A study by Concepcion *et al.* (2006) identified significant differences between the perceptions of Filipino vegetable farmers and their market intermediaries about the nature of consumer demand. Their divergent, often erroneous ideas and concepts about vegetable quality contributed to waste and inefficiency in the Mindanao vegetable supply chain.

Lusine *et al.* (2007) presented performance measures to assess the success of supply chains. The authors used four criteria including efficiency, flexibility, responsiveness and food quality to assess performance of value chains. Efficiency points to the utilization of resources in the supply chain and its measures include production costs, profit, return on investment and inventory. Flexibility indicates the degree of responsiveness of the supply chain to a changing environment and is measured through customer satisfaction, volume flexibility, delivery flexibility, and lost sales. Responsiveness shows the time spent in the fulfilment of a request and is measured through fill rate, product lateness, customer response time, lead-time, shipping errors, and customer complaints. Food quality, the fourth and final criteria of performance measure, is further divided into product and process quality. Product quality consists of product safety and health, sensory properties, shelf-life, and product reliability and convenience, while process quality consists of the characteristics of production and marketing systems. Hence, this study adopts all four criteria including efficiency, flexibility, responsiveness and food quality to assess performance of value chains.

A study by Rueben *et al.* (2007) infers that if a player gets disengaged from supply chain management, you run the risk of sabotaging partner strategy and customer relations and leaving money on the table now and for the long term. Another study by David Simchi-Levi *et al.* (2008) infers that supply chain performance affects the ability to provide customer value, from the most basic dimension of availability of products. Therefore, there is a need to develop independent criteria to measure supply chain performance. The need for well defined measures in the supply chain stems from the presence of many partners in the process and the

requirement of a common language. This is precisely the motivation behind standardisation initiatives such as Supply Chain Operations reference (SCOR) model. In order to strengthen this finding, in this research study, selection of supply chain performance measure metrics is adopted from SCC reference model SCOR.

Lowe and Gereffi (2009) presented the value chain of the U.S. beef industry. The inputs included the main products and services used to raise beef cattle and the services included veterinary services. Production was carried out in three stages of beef cattle farming. Distribution of the products was made through wholesalers and food service suppliers such as Sysco. Wholesalers accounted for 16 per cent of the beef market. The results showed that marketing of beef and its products were carried through supermarkets, restaurants, and food service suppliers. Food service suppliers included companies providing dining and vending services. Fresh beef consumption in US accounted for 87 per cent beef consumption. The remaining 13 per cent was processed through curing, smoking or seasoning.

Oro and Pritchard (2011) applied an evolutionary economic geography perspective to the problem of explaining value chain reforms in the Australia–Japan beef trade. It showed that nationwide supermarket chains were the key agents for the distribution of Australian beef into Japan. It also indicated that trading companies and wholesalers supplied to these distributors and cutting the captive governance chains.

2.4 Institutions Innovations

The increasing acknowledgement of the role of institutions in social life involves the recognition that much of human interaction and activity is structured in terms of overt or implicit rules. The use of the term institution has become widespread in the social sciences in recent years, reflecting the growth in institutional economics and the use of the institution concept in several other disciplines, including philosophy, sociology, politics and geography. The term has a long history of usage in the social sciences, dating back at least to Giambattista Vico in his Scienza Nuova of 1725 (Hodgson, 2006). However, even today, there is no unanimity in the definition of this concept. The words institution and organization are usually used interchangeably or inclusively and often lead to misunderstandings. Furthermore, endless disputes over the definitions of key terms such as institution and

organization have led some writers to give up matters of definition and to propose getting down somehow to practical matters instead. But it is not possible to carry out any empirical or theoretical analysis of how institutions or organizations work without having some adequate conception of what an institution or an organization is.

de Capitani and North (1994) defined institutions as the rules in any kind of social structure, i.e. the laws, regulations and their enforcement, agreements and procedures. Organizations, on the other hand, refer to a group or association, formal or informal, in which there are defined and accepted roles, positions and responsibilities structured in some relationship to each other in order to achieve a specific objective (Uphoff, 1992). Uphoff (1992) stressed that organisations can be formalised, such as official sector organisations with operational objectives, their own budget and professional staff such as water departments in Government Ministries, Water Boards, Environmental Protection Agencies, laboratories, consultant companies or they can be informal.

Institutions have been defined as regulative, normative, and cognitive structures and activities that provide stability and meaning for social behaviour (Scott, 1995). Examples of institutions include laws, regulations, customs, social and professional norms, culture, and ethics. Institutions exert a constraining influence over organizations, called isomorphism, which forces organizations in the same population to resemble other organizations that face the same set of environmental conditions (Hawley, 1968). Institutions exert three types of isomorphic pressure on organizations: coercive, normative, and mimetic (DiMaggio & Powell, 1983). Coercive isomorphism refers to pressure from entities that have resources on which an organization depends. Mimetic isomorphism refers to the imitation or copying of other successful organizations when an organization is uncertain about what to do. Normative isomorphism refers to following professional standards and practices established by education and training methods, professional networks, and movement of employees among firms.

Institutional theory posits that institutionalised activities occur due to influences on three levels: individual, organizational, and inter-organizational (Oliver, 1997). On the individual level or institutional arrangement, managers follow norms, habits, customs, and traditions, both consciously and unconsciously (Berger & Luckmann, 1967). On the organizational

level, shared political, social, cultural, and belief systems all support following traditions of institutionalized activities. On the inter-organizational level, pressures from government, industry alliances, and expectations from society define what is socially acceptable and expected organizational behaviour, which pressures organizations to look and act the same (DiMaggio & Powell, 1983). Institutional arrangement refers to a set of rules or agreements governing the activities of a specific group of people pursuing a certain objective (Eaton *et al.*, 2008). Different types of examples include a contract (such as simply to exchange goods, or a sharecropping agreement between landlord and tenant farmer), a producers' organisation (an agreement among farmers perhaps to jointly purchase inputs or deliver produce to clients), and so on. Institutional arrangements thus involve agreements to exchange or coordinate goods or services (such as labour). Concluding and enforcing such agreements entails the expenditure of resources, referred to as transaction costs. This study adopts the definition given by de Capitani and North (1994) and Eaton *et al.* (2008) and focus on institutional arrangements.

Based on aforementioned, institutional innovations were defined as redesigning the roles, relationships and governance structures required to bring participants together in productive endeavours. Institutional innovations trump either product or process innovation in terms of potential for value creation. Through institutional innovation, organizations can build creation spaces that help facilitate (rather than limit) interactions and relationships, allowing organizations to increase the flow of information within and across their organization's walls to increase learning, adaptability, and downstream product and process innovations (Hagel and Brown, 2013). Institutional innovation requires embracing a new rationale of scalable learning with the goal of creating smarter institutions that can thrive in a world of exponential change.

Briggs (1998) examined the differentiated effects of bonding capital and bridging capital on economic well-being at the individual level. This study used a sample of residents of a New York public housing program to investigate social support capital (bonding capital) and social leverage capital (bridging capital). The study used three questions to indicate social support capital: (1) daily aid such as getting rides, borrowing a little money, or running errands; (2) emergency aid for a serious illness or providing temporary accommodation; and (3) finding someone to talk to about family relationship troubles. Networks of kin and friends were

regarded as the major carriers of this social support capital. Three different proxies were used to indicate social leverage capital that helped people to get ahead: (1) job information; (2) advice on future plans; and (3) advice on school classes or programs. Networks of people with heterogeneous backgrounds were deemed to be the major carrier of this type of social capital. The study found that black adolescents with higher levels of social leverage capital, such as networks including white people, had more perceived job information. Unfortunately, a high proportion of these black adolescents lacked such leverage capital.

Some studies have employed measures similar to those used by Briggs (1998) although they had used concepts other than bonding and bridging capital in framing the research. For example, using data from the Italian National Institute of Statistics and other sources, Sabatini (2008) examined the impact of four types of regional level social capital (strong family ties, networks with kin and friends, voluntary group affiliations and activities engagement, and political participation) on human development and other well-being. The index of human development in this study consisted of per capita income, life expectancy, and high school attendance. The study found that the level of voluntary organizational affiliations at the regional level exhibited a positive impact on human development. In contrast, strong family ties and networks with kin and friends actually showed negative effects on human development, although they did improve life quality by reducing worker instability.

Durkin (2000) used data from the GSS to examine whether individual voluntary group memberships and social interactions such as help from relative and friends for household work, money borrowing, advice, and emotional support, affected wages. His study found that social interactions with family members and friends were positively associated with wages in certain groups.

A study by Williams (2002) examined how innovations of institutional arrangements facilitated reforms in Mexico and Argentina. It found that executive leadership helped facilitating institutional change, but that technocrat policymakers played more crucial roles than previously documented. Through rule changing, instrument-creating, and strategizing behaviours, they helped engineer their own autonomy and gained control of the policy agenda by changing the organization of decision making, and the position they occupied in the

bureaucracy. The study concluded that successful market reform projects require significant revision of government agencies, institutional arrangements, and policy-making procedures, in part, to provide reformers autonomy from countervailing pressures.

Das (2004)'s qualitative study in India examined the impact of the social economic status of poor workers on their social capital condition. The findings suggested that although reciprocal interactions among poor families in the communities were common and frequent, the interactions between poor families and middle income and economically advantaged families were rare.

Hutchinson (2004) found that, in a Los Angeles community lacking trust and safety, it was hard for poor people to establish bridging capital with people of better social economic status. The community had been a place mainly occupied by affluent people, but later evolved into a hotbed of drug dealing and violence after many original residents moved to suburban areas. The prevalence of violence and crime in this community made it very difficult for people of different social and economic backgrounds to establish interactive relationships. Although these descriptive studies provide insight about the effect of economic status on social capital, one major limitation is that they cannot disentangle economic factors from other influential factors in examining the impacts on social capital development.

Using data from the Women's Employment Survey, Henly *et al.* (2005) examined the impact of perceived social supports on the economic well-being of single mothers with TANF experience. The social supports investigated, such as engaging relatives and friends in helping with errands, childcare, emotional support, and money borrowing, fit the concept of bonding capital well. The findings suggested that, although the social supports did not show a significant impact on monthly income or job quality, they reduced the likelihood of living in poverty and experiencing hardships in housing, food, or medical care among study participants. Lombe and Ssewamala (2007)'s study investigated the impact of informal social networks on micro-savings outcomes. The study defined three types of informal social capital: community involvement indicated by activities such as election participation, giving help to kin and friends, and receiving help from kin and friends. The results showed that community involvement and receiving help did not affect respondents' saving activities, but giving help was negatively associated with saving activities.

Institutional analysis has taken on an increasingly important role in the study of economic growth in recent years (North, 2005). In keeping with a certain neo-institutional orthodoxy, the latest reports by international institutions and a substantial body of research raise the question of the right institutions or rules of play as a prerequisite to achieving optimal efficiency for developing or transitional economies (World Bank, 2005). World Bank (2005) indicated that taking account of institutions not only enables the debate to be centred on individuals, their interactions and behaviours in the shaping of societal trends, but also to break with the idea that simply implementing an appropriate institutional framework enables efficiency and general welfare to be achieved, as asserted by the most ardent defenders of the market economy. Distinguishing between rules of play and players has become a common method for analyzing institutional change. Rules of play change so as to provide the players with opportunities they can interact with and even change. Institutional change is possible only if informal rules do not delay nor stop neither the actions of the players nor the change in formal rules.

A study by Batt (2006) examined the potentials for various forms of institutional innovations in building competitiveness of smallholder agriculture in coffee, sisal and sugar subsectors of Tanzania. In the study on the coffee subsector, it was established that while the evolution in the pattern of global production and consumption of coffee have led to the bifurcation of markets, Tanzania failed to position itself within a particular segment of the market and got stuck in the middle. This failure was associated with the evolution of its policy and organization of production, which deconstructed institutions that were crucial to the production and export of high quality coffee. The study further found that industrial policy initiatives had been pioneered by non-state institutions to relocate coffee producers within the high-quality segment of the market.

The study in the sisal subsector showed that the integration of smallholders in sisal production by private companies was a disguised form of a piece-employment relationship rather than a business partnership as it was construed to be. Underlying this relationship was a substantial imbalance characterized by the company's full control over all key resources, including land, processing facilities and output marketing. The study concluded that in the absence of countervailing powers mediated in non-market institutional settings, this form of integration could not be expected to promote the competitiveness of Tanzanian sisal.

In the sugar subsector, the study found that even as the intermediary organizations of cane out-growers had played significant roles in reducing transaction costs and promoting market linkage and access to credit markets, an increase in productivity required for competitiveness was limited by the character of its production and limited collective actions through horizontal coordination. The findings from the three case studies suggested that improving export crop competitiveness of smallholder producers required strategies to promote coordination at the meso level, directed at eliminating binding constraints specific to the relevant subsectors.

Wolz *et al.* (2006) studied the impact of social capital on economic performance of agricultural producers in the Czech Republic. The factor analysis was employed to extract independent factors from a set of correlated variables. Linear multiple regression model was fitted to test whether there was any significant impact of social capital factors on gross farm income. They concluded that social capital does have a significant positive influence on farm performance in the Czech Republic.

Ghafoor (2007) observed that there were no proper arrangements for generating and handling exportable surplus of mangoes from Pakistan. Efforts were generally made at individual level with very little utilization of centrally organized platforms. He remarked that amongst others, poor farm production practices, inappropriate post harvest management, inefficient marketing practices and lack of infrastructure affected exports of mango from Pakistan. Short life span of varieties and over dependence on few mango varieties for export purpose determined limits in export. He argued that extra burden on Karachi terminal market affected efficiency in the export business. He recommended that new terminal points should be established and vapour heat treatment facilities made available to exporters at affordable price to increase export of quality product.

Milagrosa (2007) examined vegetable production and marketing among indigenous communities in northern Philippines using an institutional economics approach. The study focused on the four levels of institutions; social embeddedness, institutional environment, governance structures and resource allocation and on the structure, conduct and performance of the vegetable sector. Using this integrated framework, the thesis engaged on a range of topics from the structure of the sector to sales and margins, from trust to favoured-buyer

systems and from transaction cost analysis to farmer's decision-making processes. Also, a framework that aligns efficient contract types with governance structures based on observable transaction attributes was developed. The modelling approach that determines how farmers choose trading partners based on farm and farmer characteristics, transaction attributes and social capital was used. The important finding of the study was the social capital of farmers and traders in the province, aggregated from scores on trust, associatedness, common goals and optimism, was low. The social capital was ineffective in facilitating market information exchange and providing countervailing power to farmers in selling crops.

Beugelsdijk and Smulders' (2009) study distinguished between the economic impacts of bonding and bridging capital at the aggregate level. The study measured the aggregate bonding and bridging capital of 54 European regions. Bridging capital was represented by memberships in a series of voluntary organizations resembling those analyzed by Putnam (1995) and Knack and Keefer (1997), including memberships affiliated with religion, education, arts, music, cultural activities, and youth work. Bonding capital was represented by ties with family, friends, and acquaintances. The results indicated that bridging but not bonding capital was positively associated with regional economic growth.

Astudy by Woodhill (2010) on capacities for institutional innovation found that America failed to deal effectively with Hurricane Katrina, it was not because of a lack of machinery, military transport, or communications equipment – it was the institutional arrangements. The study argued that the global challenges call for institutional innovation that entails a very different dynamic of the relations within society. Changing institutions, be it related to societal norms and values, government policies, market incentives, political systems or organisational processes, requires the soft capacities of communication, trust building, diplomacy, networking, making sense of messy social situations, political advocacy and leadership. The study outlined four specific capabilities required for institutional innovation as navigating complexity, learning collaboratively, engaging politically and being self-reflective.

Wolz *et al.* (2010) assessed whether social capital affected farm income using micro-data from 255 household plot farmers in Ukraine. The data reflected 23 social capital indicators. These were merged in four separate index variables. The index variables reflected the

theoretical dimensions of social capital, namely form, i.e. structural and cognitive, and relationship, i.e. bonding and bridging. By adopting multiple regression analysis, it was shown that social capital in the form of bridging was indeed a significant factor for determining the level of agricultural income. However, the findings also underlined the multidimensional side of social capital. Both bonding and cognitive social capital showed no immediate impact on agricultural income among household plot farmers in Ukraine.

Kasarjyan (2011) analysed by means of Social Network Analysis the role of social capital (bonding and bridging dimensions) in accessing productive resources, in particular access to information and micro-credit. In addition, it determined empirically the significance of social capital (structural and cognitive dimensions) for the credit repayment performance of joint liability borrowing group members. The logit regression was employed since the dependent variable was binary. The significance of both cognitive and structural social capital showed that it was essential to consider different dimensions of social capital in such an analysis.

METHODOLOGY

3. METHODOLOGY

This chapter explicates the research methodology that was used in this study. Firstly, essential background about study area was presented. The subsequent sections described nature of data used, sampling design, data collection and data analysis.

3.1 Zimbabwe's agro-ecology zones

Historically, Zimbabwe was considered the bread basket of Southern Africa because of its agro-ecological characteristics. However that tag became a misnomer following Land Reform Programme meant to redistribute the land to the disadvantaged citizens. Zimbabwe's agricultural sector is divided into four major sub-sectors namely; large scale commercial farms, small scale commercial farms, communal and resettlement areas. The agrarian structure has changed with the recent land reform in Zimbabwe with 99 per cent of the farmers now being smallholder farmers. Of these, 81 per cent are communal farmers, 18.7 per cent resettled farmers and 0.1 per cent large scale farmers.

Zimbabwe is a landlocked country in the Southern Africa region with an area of over 390 000 km^2. It is bordering Mozambique to the east, South Africa to the south, Botswana to the west and Zambia to the north. It extends from latitudes 15°37' S to 22°24' S and from longitudes 25°14' E to 33°04'E. Altitude ranges between 197 m and 2592 m. About 80 per cent of the land is higher than 600 m and less than 5 per cent is above 1500 m, with the highest part in the Eastern Highlands. The Zambezi, Save and Limpopo are the major rivers. Zimbabwe lies entirely within the tropics but much of the Highveld and Eastern Highlands have a subtropical to temperate climate due to the modifying effect of altitude. Three distinct seasons are discernible. These are: a hot wet season from mid- November to March (summer), a cold dry season from April to July (winter), and a hot dry season from August to mid-November (spring).

Air temperatures are closely related to altitude with mean annual temperature ranging from about 25°C in parts of the Zambezi Valley to less than 15°C above 1800 m in the Eastern Highlands. Maximum temperatures are lowest in June or July and highest in October. During winter, mean daily temperature ranges between 11 and 20°C. Mean maximum daily

temperatures can exceed 32°C during spring. Frost may occur in most areas between May and August, with the highest incidence in June and July. It occurs more frequently and more severely at mid and high altitudes. Severe frosts are associated with an influx of cold dry south-westerly air that mostly affects the Kalahari Sandveld and Southern Highveld regions. Local topography, however, is the main determinant of frost risk with valleys, vleis and other sites which receive and retain cold night air being especially susceptible. The Mid Zambezi Valley is probably the only frost-free region.

Humidity (depends mainly on the season and the time of day (20% in September to an uncomfortable 80% in January). In most places, the air temperature varies within the temperate/sub-tropical range of 10° to 28°C. The climatic comfort is generally optimum in most parts of the country, except during the month of October which is extremely hot but not so in the eastern highlands. However, people living in the lowlands of the Zambezi and Limpopo valleys endure prolonged heat stress. Climatic conditions are largely sub-tropical with one rainy season, between November and March.

Rainfall varies widely both temporally and spatially. The reliability of rainfall increases with altitude and from south to north. Coefficients of variability range from greater than 40 per cent in areas south of Bulawayo to less than 20 per cent in some parts of the Highveld and Eastern Highlands. About 90 per cent of the total rainfall in Zimbabwe is associated with thunderstorm activity producing falls of short duration and high intensity. Periods of drizzle and light rain (guti) are only significant in the southeast of the central watershed, but total amounts contributed by this type of rainfall are small. Local variation in the regional rainfall pattern caused by orographic effects occurs in several areas.

Zimbabwe has been classified into various climatic regions based on annual rainfall, rainfall distribution and elevation. These zones are based on the ratio of the 80 per cent probability of the mean annual rainfall and the average annual evapotranspiration (Bernardi and Madzudzo, 1990). The resulting five natural regions are as follows.

3.1.1 Natural Region I (NR I)

The region lies in the east of the country. It is characterized by rainfall of more than 1 000 mm/year (most of which falls throughout the year), low temperatures, high altitude and steep slopes. The country's timber production is located in this region. The plantations are owned mainly by the State through the Forestry Commission and by multinationals. NR I is ideally suitable for intensive diversified agriculture and livestock production, mainly dairy farming. Common crops are tropical crops such as coffee and tea, deciduous fruits, such as bananas and apples and horticultural crops, such as potatoes, peas and other vegetables such as tomatoes. Flowers, such as proteas (*Proteaceae* spp.), are grown for export.

3.1.2 Natural Region II (NR II)

This region is located in the middle of the north of the country. The rainfall ranges from 750 to 1 000 mm/year. It is reliable, falling from November to March/April. Because of the reliable rainfall and generally good soils, NR II is suitable for intensive cropping and livestock production. It accounts for 75-80 per cent of the area planted to crops in Zimbabwe. The cropping systems are based on flue-cured tobacco, maize, cotton, wheat, soybeans, sorghum, groundnuts, vegetables, seed maize and burley tobacco grown under dryland production as well as with supplementary irrigation in the wet months. Irrigated crops include wheat, tomatoes and barley grown in the colder and drier months (May-September). NR II is suitable for intensive livestock production based on pastures and pen-fattening utilizing crop residues and grain. The main livestock production systems include beef, dairy, pig and poultry. Prior to 2000, the region was dominated by the large-scale farming subsector characterized by highly mechanized farms of 1 000-2 000 ha under freehold title and owner-operated. Following the agrarian and land reform programmes initiated in 1999/2000, a large proportion of the farms were subdivided into smaller units and allocated to new farmers under the A1 and A2 small-scale farming system.

3.1.3 Natural Region III (NR III)

NR III is located mainly in the mid-altitude areas of the country. It is characterized by annual rainfall of 500-750 mm, mid-season dry spells and high temperatures. Production systems are based on drought-tolerant crops and semi-intensive livestock farming based on fodder crops. The predominant farming system is smallholder agriculture. Large-scale farming accounts for

15 per cent of the arable land production, most of the land is being used for extensive beef ranching (Roth, 1990). Smallholder agriculture in the communal farming areas is under relatively intensive cropping systems. The main crops are maize (the staple foodgrain) and cotton (a major cash crop). NR III is suitable for the production of groundnuts and sunflowers as cash crops.

3.1.4 Natural Region IV (NR IV)

NR IV is located in the low-lying areas in the north and south of the country. The characteristics of the region are: annual rainfall of 450-650 mm, severe dry spells during the rainy season, and frequent seasonal droughts. Although NR IV is considered unsuitable for dryland cropping, smallholder farmers grow drought-tolerant varieties of maize, sorghum, pearl millet (mhunga)and finger millet (rapoko). NR IV is ideally suitable for cattle production under extensive production systems and for wildlife production.

3.1.5 Natural Region V (NR V)

NR V covers the lowland areas below 900 m above sea level in both the north and south of the country. The rainfall is less than 650 mm/year and highly erratic. Although NR V receives reasonable rainfall in the northern part of Zimbabwe along the Zambezi River, its uneven topography and poor soils make it unsuitable for crop production. Generally, NR V is suitable for extensive cattle production and game-ranching. Although both NR IV and NR V are too dry for crop production, households on the communal lands in these regions grow grain crops (maize and millet) for their food security and some cash crops such as cotton. Crop yields are extremely low and the risk of crop failure is high in one out of three years (Rukuni and Eicher, 1994). Cattle and goat production are major sources of cash income.

3.1.6 Soil quality and fertility

There are many different soil types in Zimbabwe. There are soils derived from granite (most common rock), predominantly that named sandveld (with little clay content) which drains well, dries quickly and has low organic matter and phosphorus; then there is paragneiss - a soil which is a result of the weathering of an unusual rock type reformed from granite (brown, slightly red sandy loams).

Black turf soils (very fertile, heavy clay, hard when dry, very sticky when wet) are derived from a less common rock, basalt. Dolorite weathers to rich red clay soils scattered throughout Zimbabwe. Kalahari sandstone weathers to Kalahari sands (very fine grained soils of low fertility found in the drier regions of the west of the country. Serpentine, the most common rock on the Great Dyke, weathers to shallow greyish brown sand loam soils unsuitable for crop production because of presence of nickel and chromium salts that are harmful to plant growth. Norite is a rock found in some sections of the Great Dyke and forms clay soils more like black turf soils (north and south of Selous).

Mopani soils are found in dry areas and composed of heavy clay and are very alkaline. Two main types of dambo soils occur in Zimbabwe and have been characterised thus;

a. Calcic hydromorphic soils comprise dark grey or black clays with a high base status. The dominant clay is montmorillonite, hence these soils resemble vertisols in their behaviour with respect to expansion and contraction during wetting and drying phases. Whitlow (1985) further stated that carbonate concretions sometimes occur in subsoils within zones of fluctuating water table. Calcic hydromorphic soils occur in broad depressions on mafic rocks in areas receiving over 600 mm rainfall per year. The mafic rocks comprise dark humic soils overlying light coloured sandy or sandy clay soils which generally have a low base status, with kaolinite being the prevalent clay mineral. Whitlow (1985) found that mottling and iron concretions are common in subsoils within dambo margins.

b. Non-calcic hydromophic soils originate from siliceous parent materials and are the most extensive of the dambo soils in Zimbabwe covering in excess of one million hectares of dambo land (Whitlow, 1985).

According to Government of Zimbabwe (GOZ, 2010), many crops on granite sandy soils on the communal lands reveal multiple nutrient deficiencies of N, P and S as well as of magnesium (Mg) and potassium (K) and of micronutrients such as zinc (Zn).S deficiency is endemic. Mg deficiency is more pronounced where the sandy soils are cropped using fertilizer NPK alone. Zn deficiency is encountered more in intensively cropped areas. The soils are inherently deficient in boron (B). Copper (Cu) deficiency occurs in irrigated lands. Generally, there is no iron (Fe) deficiency (GOZ, 2010).

3.2 Description of the study area

Zimbabwe is divided into nine provinces namely Bulawayo, Harare, Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo Province, Matabeleland North, Matabeleland South, and Midlands Province. Mashonaland Central, Mashonaland East and Mashonaland West provinces constitute the breadbasket of the country. The study was conducted in the Mashonaland East of Zimbabwe (Figure 3.1). Mashonaland East was purposively selected as it contributes approximately 35 per cent of total tomato production in the country. Mashonaland East is divided into nine districts: Mutoko, Mudzi, Murehwa, Uzumba-Maramba-Pfungwe (UMP), Goromonzi, Marondera, Wedza, Seke and Chikomba.

The province is mainly characterized by farming, urban, peri-urban and rural communities. Mashonaland East Province has an area of 30, 734 km². The area is not very densely populated with 34 people per km^2 and a total population of around 1,200,000 people, which is about 11 per cent of the total Zimbabwe population. Its coordinates are 17°30'0" S and 32°0'0" E in DMS (Degrees Minutes Seconds) or -17.5 and 32 (in decimal degrees). Its Universal Transverse Mercator (UTM) position is UF96. Mashonaland East Province has an average elevation of 1,026 meter above sea level.

The province is mainly composed of mostly rural communities, rural resettlements areas, A1 and A2 and also sizeable number of commercial farms are found especially in and around Mutoko, Macheke, Marondera, Seke and Murewa districts. People in communal areas rely mainly on subsistence farming and those near farms found livelihoods as farm workers. The province is situated in agricultural region 2 and 3 which on average receives annual rainfall of about 500mm-1000. High rainfall and very cold temperatures are usually recorded around Murewa, Mutoko and Macheke and Marondera districts.

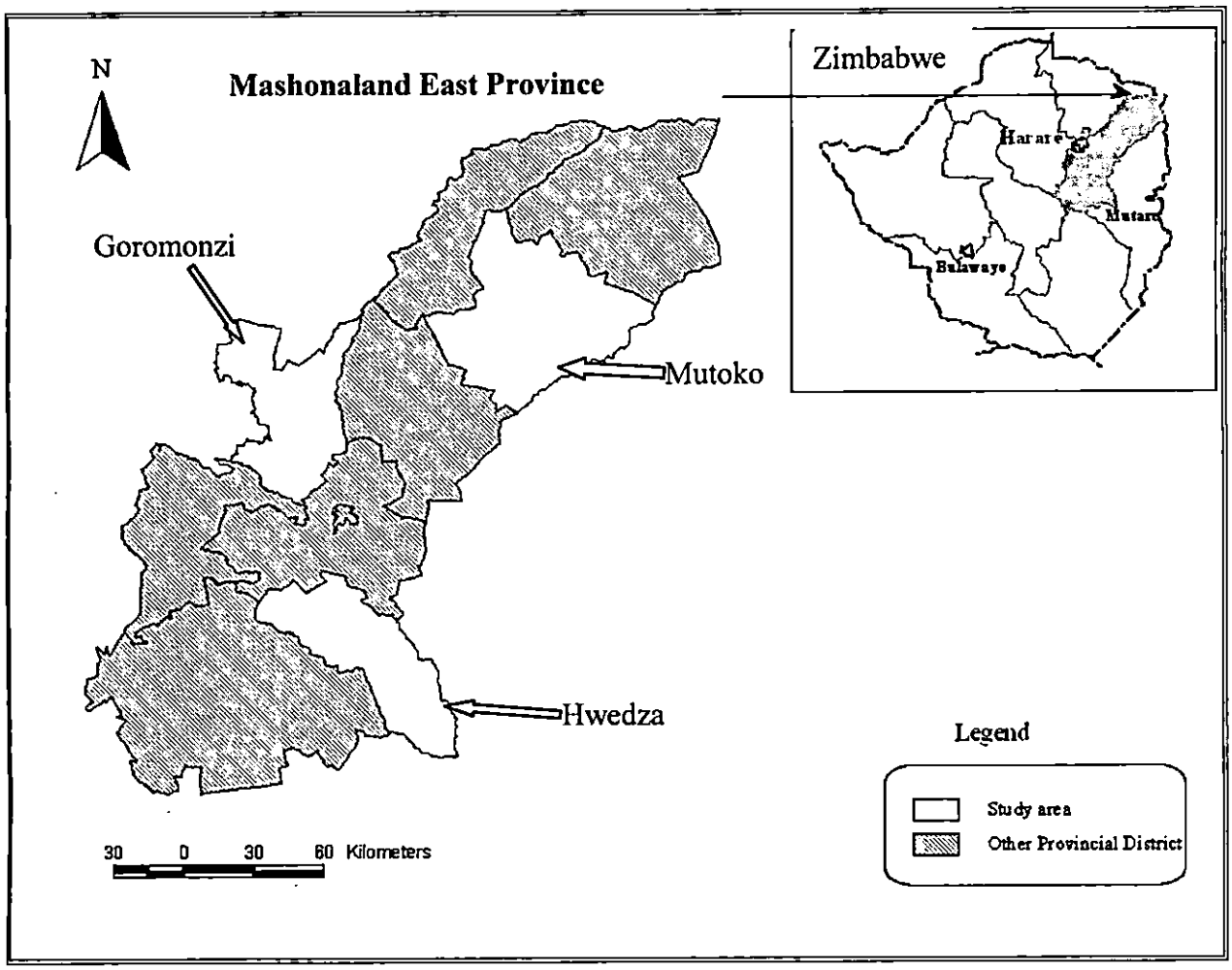
The month of October is warmest with an average temperature of 30.1 °C at noon. July is coldest with an average temperature of 6.5 °C at night. Mashonaland East Province has no distinct temperature seasons; the temperature is relatively constant during the year. Temperatures drop sharply at night. In winter there may be some days it freezes; overall winters are mild in temperature, with the coldest month most often being July. August is on average the month with most sunshine. Rainfall and other precipitation peaks around January.

The time around August is driest. The province has a humid (> 0.65 p/pet) climate. Mashonaland East province has some of the most fertile lands in Zimbabwe and the lands are particularly suited to small-scale irrigated production. Irrigation agriculture draws water from one or more of the following sources: open shallow wells, rivers/streams, dams, boreholes and deep wells, rain water, infiltration pits and springs. The most common water sources are open shallow wells, rivers and small dams followed by boreholes, deep wells, rainwater, infiltration pits and springs. Springs were however, normally used for drinking water and rarely for irrigation. The landscape is mostly covered with mosaic vegetation/croplands. The climate is classified as a humid subtropical (dry winter, hot summer), with a subtropical dry forest biozone. The soil in the area is high in lixisols (lx), soil with clay-enriched lower horizon, low cec, and high saturation of bases.

3.3 Sampling frame and sample selection

Mashonaland East is divided into nine districts: Mutoko, Mudzi, Murehwa, Uzumba-Maramba-Pfungwe (UMP), Goromonzi, Marondera, Wedza, Seke and Chikomba. Multi-stage random sampling technique was adopted for sample selection. The sampling frame was provided by Ministry of Agriculture. In the first stage, tomato growing districts were identified. Out of nine districts, six districts namely Hwedza, Marondera, Murehwa, Goromonzi, Mutoko and Mudzi constituted the universe of the study. Three districts were randomly chosen for the study: Goromonzi, Murehwa and Hwedza. From the selected districts a sample of 12 villages was selected and 10 farmers were randomly selected from each of the 12 selected villages, thus making a total of 120 farmers. In addition, the samples of 10 wholesalers, 10 processors, 10 big supermarkets, 10 small retailers and 10 officials from the Ministry of Lands, Agriculture and Rural Development were selected.

Figure 3.1 Location of the study area



3.4 Data collection

The study was based on both primary and secondary data. Primary data were collected with the view of analysing key stakeholders, including smallholder famers, supermarkets, processors and wholesalers and identifying socio-economic factors that influence participation of smallholder farmers in different market channels. The data were collected by means of interviews and structured questionnaires and were collected between early March 2013 and August 2013.

Secondary data were obtained from Agritex, Zimbabwe Farmers Union (ZFU) and Agricultural Marketing Authority (AMA. The average weekly and monthly nominal price data were spanning from January 2011 to August-2013. Six municipal tomato fresh markets were identified as they represented major outlets of tomatoes in the country namely Gweru, Chiredzi, Mbare, Mutare, Masvingo, Chiredzi and Bulawayo.

3.5 Analytical tools employed

Both qualitative and quantitative methods have been used to analyse the data collected to address the objectives of the study.

3.5.1 Descriptive Analysis

Descriptive analysis was employed to produce a situation analysis. Descriptive statistics were applied to production, household and marketing characteristics. Since descriptive analysis provides a snap shot of the situation under study, it was used throughout data analysis in different ways. The Z-tests and student t-tests were used to test for significant differences in means and/or proportions across market categories and X^2-test for the association between variables. Although descriptive statistics was used throughout data analysis it was mainly used for the first objective, which focused on identification and characterisation of the tomato supply chains and typology of farmers across two categories of markets.

3.5.2 Price Behaviour

Price movement influences the decisions of farmers, traders and consumers regarding the transactions and consumption of the commodities in the market. Understanding patterns of movement in time series variables is useful for making better forecasts in marketing decisions such as when to buy and when to sell. In this study an attempt has been made to explore changes in price seasonal patterns in the area under study and how price change in one market affects other major tomato markets in Zimbabwe. Therefore, price behaviour was studied under price seasonality and spatial market efficiency. The price behaviour was studied using the techniques of classical time series (Spiegel, 1992).

3.5.2.1 Seasonality analysis

The study of seasonal tendencies in price movement, also known as seasonality is an area of market analysis intended to identify price patterns and possible turning points within the span of a year. The goal was to identify a rhythm for price movement and the timing of peaks and troughs or if there was symmetry to these patterns that provided guidance to upcoming tops and bottoms.

Economic time series variables (e.g., prices, sales, purchases, stocks, etc) are composed of four key components: Long-term trends (T), Seasonal components (S), Cyclical components (C) and Irregular or random components (I). These components, when examined individually can help to better understand the sources of variability and patterns of time series variables, hence time series decomposition. There are several ways of decomposing time series variables (e.g., additive model, multiplicative model).The price time series data on tomato were assumed to operate proportionately to the general level of the series, thus , multiplicative model was perceived as the appropriate model in respect to trend, seasonal, cyclical and irregular components. The basic multiplicative model is given as:

$P_t = T_t \, x \, S_t \, x \, C_t \, x \, I_t$

Where:

- $\mathbf{P_t}$ is the time series variable of interest (tomato price)
- $\mathbf{T_t}$ is the long-term trend in the data
- $\mathbf{S_t}$ is a seasonal variation
- $\mathbf{C_t}$ is the cyclical variation
- $\mathbf{I_t}$ is the irregular or random variations in the series.

As one of the critical components, especially in cases of agriculture production, marketing of goods and commodity pricing, seasonality was studied as data were recorded on monthly time interval.

Seasonal studies are generally done on daily, weekly or monthly data. In fact, many analysts restrict their work to weekly or monthly data only. Daily data may be prone to an excess of noise in an area of study intended to see ebb and flow on a higher level. Hence, the study used nominal monthly price data of tomatoes to measure the seasonal patterns from area of study. There are several different techniques which are used to isolate and examine individually the different components of time series variables. The current study used the ratio-to-moving average method, which eliminates both, the trend as well as cyclical fluctuations from the time series. The various steps involved in the computation of seasonal indices by the ratio to moving average method are as follows:

Step 1: Obtain the 12 monthly moving averages of the original data.

Assuming a 12-month period, the moving average for a time period t (MA_t) is calculated as:

$MA_t = (P_{t-6} + \ldots + P_t + \ldots + P_{t+5}) / 12$

For monthly data, the number of periods (12) is even and is not centered, therefore, it is necessary to center it. To center the moving averages, a two-period moving average is calculated as follows:

$$CMA_t = (MA_t + MA_{t+1}) / 2 \ldots\ldots\ldots$$
$$= Tt \times Ct \ldots\ldots\ldots$$

Since variations recur after 12 months for a monthly data, a 12 months moving average eliminates the seasonal fluctuations if they are regular and constant. Thus the 12 monthly moving average values contain trend and cyclical fluctuations only because in the process of averaging, even the irregular fluctuations would disappear.

Step 2: Measuring the degree of seasonality

Each original value of the time series is expressed as percentages of the trend value. In multiplicative model, it is expressed as follows:

$$SF_t = (P_t / CMA_t) * 100$$
$$= T_t \times S_t \times C_t \times I_t / (T_t \times C_t)$$
$$= S_t \times I_t$$

where P_t is the actual value, *CMA* is centre moving average, SFt is the seasonal factor and others are defined as before. Thus, ratio to moving average represents the seasonal and irregular components.

Step 3: Establishing average seasonal index

This is obtained by taking the average of seasonal factors for each season. Take the sum of SFs for the month of January and divide by the number of SFs for January over the entire data period. Averaging removes irregular component and seasonal index is obtained.

3.5.2.2 Spatial market efficiency

S

In analysis the study proceeds as follows:

1. The study tested whether the time series were stationary, which was a necessary condition for the further testing procedure. Several statistical tests have been developed to determine if a series is stationary. These are also known as unit root tests. In this study Augmented Dickey-Fuller test (ADFt) was employed. The decision was arrived through following the steps given below:

a) Start with no intercept and no trend. Check both the autocorrelation (i.e. Durbin Watson test (DW) statistic and ADF statistic). If DW is close to 2 then the test is reliable (no autocorrelation among residuals) If ADF is less (even more negative) than the negative critical value, then the series is stationary.

b) If DW is not close to 2, try with an intercept redo 1

c) If DW is still not close to 2, try with an intercept and trend redo 1

d) If ADF statistic is greater than the negative critical value then the series is not stationary. Difference the series once and redo 1 (and 2 and 3 if necessary). If the new series found to be stationary then the original series has one unit root.

e) If not, difference again and redo 1-4 until you achieve stationarity.

To carry out the test, ADF test consists of estimating the following regression:

$$\Delta P = \delta P_{t-1} + \Sigma \beta_1 \Delta P_{t-1} + e_{it} \qquad 1$$

where, $\Delta Pt_{-1} = P_{t-1} - P_{t-2}$, t = time indicator, i = commodity price series, i.e. tomatoes, e_{it} is a pure white noise and δ is the coefficient presenting process root, i.e. the focus of testing.

The null hypothesis of the Augmented Dickey-Fuller t-test is

H_0: $\theta = 0$ (i.e. the data needs to be differenced to make it stationary)

versus the alternative hypothesis:

H_1: $\theta < 0$ (i.e. the data is stationary and doesn't need to be differenced)

2. Estimation of the long-run relationships

There are a number of models that can be used to estimate long-run relationship such as Engle-Granger and Johansen Maximum Likelihood Procedure just to mention few. The Johansen Maximum Likelihood approach has a number of advantages over the Engle-Granger two stage approach. As Johansen Maximum Likelihood approach is a Vector Autoregressive (VAR) model based technique, less concern is needed over whether the explanatory variables are exogenous or endogenous. Restrictions can be applied to the co-integrating vectors, which is not possible with the Engle-Granger approach. It can also be used for Granger Causality testing, where the lags in the error correction model can be jointly tested for significance, thereby determining any short-run causality from the explanatory

variables to the dependent variable. Based on these advantages, Johansen Maximum Likelihood approach was used to estimate long-run relationship.

The Johansen cointegration analysis procedure relies on the relationship between the rank of a matrix and its characteristic roots. Enders (2004) noted that Johansen procedure could be viewed as a multivariate generalisation of the Dickey-Fuller test. Johansen suggested to start with a traditional VAR, to select appropriate number of lags based on the likelihood ratio test or alternatively Akaike Information Criterion (AIC) statistics, to estimate the vector error correction model and determine the rank of the matrix of parameters.

The co-integration of the system is tested using the maximum likelihood *Lmax* (*r*) which is a function of the cointegration rank *r*. Johansen describes two test methods: a) Trace Test and b) Maximum Eigenvalue Test. These statistics are then used to determine the number of cointegrating vectors . The test is based around an examination of the π matrix, where π can be interpreted as a long-run coefficient matrix. The test for cointegration between the variables is calculated by looking at the rank of the π matrix via its eigenvalues. π can be defined as the product of two matrices:

$$\pi = \alpha\beta'$$

The matrix β gives the co-integrating vectors, while α gives the amount of each co-integrating vector entering each equation of the vector error-correction model (VECM), also known as the adjustment parameter. The main difference between the two test statistics is that the trace test is a joint test where the null hypothesis is that the number of co-integrating vectors is less than or equal to *r*, against a general alternative that there are more than *r* (*r* is the rank of π and determines the number of cointegration vectors). The maximum eigenvalue test conducts separate tests on the individual eigenvalue, where the null hypothesis is that the number of co-integrating vectors is *r*, against an alternative of (*r*+1). The two statistics are:

$$\lambda_{Trace}\ (r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{Max}\ (r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

Where $\hat{\lambda}_i$ is the estimated value for the *i*th ordered eigenvalue from the π matrix. The trace and maximum eigenvalue statistics are compared to the appropriate critical values.

3. If the study concludes co-integration, the study estimates the vector error-correction model VECM. As suggested by Enders (1995), a maximum likelihood approach based on a finite VAR model can be specified to determine whether the system of equations are co-integrated.

$$X_t = A_0 + A_1X_{t-1} + \cdots A_pX_{t-p} + v_t,\ t = 1,2, \cdots T \qquad 2$$

where p = lag length; X_t = a (n×1) vector of endogenous variables; A's are matrices of unknown parameters; and υ_t is an independently and identically distributed n dimensional vector with zero mean and variance matrix εt. According to Mohammad and Verbeke (2010) the next step is specifying a VAR model in an error correction form. Following Johansen (1988, 1991) and Johansen and Juselius (1990) a general system of regression equations is stipulated as:

$$\Delta Xt = \tau 0 + \tau 1 \Delta Xt\text{-}1 + \ldots + \tau p\text{-}1\ \Delta Xt\text{-}(p\text{-}1) + \Pi\, Xt\text{-}p + \upsilon t \qquad 3$$

Or

$$\tau j = \tau 0 + \sum_{j=1}^{p-1} \tau j \Delta Xt - 1 + \Pi\, Xt - p + \upsilon t \qquad 4$$

Where $\tau 0 = A0$;

$$\tau j = -(I - \sum_{j=1}^{p-1} Aj);\ j = 1, 2 \ldots, \qquad p - 1 \qquad 5$$

$$\Pi = -(I - \sum_{i=1}^{p-1} Aj) \qquad 6$$

and Δ Xt is an (n×1) vector of Xt-j in first differences, and Π and τj (j = 1, 2, ……, k) are n*n matrices of parameters and υt is an n-vector of residuals which are assumed to be normally

distributed with mean zero and have a contemporaneous covariance matrix εt. The long-run information in Xt is summarized by the long-run impact matrix Π. Π is the rank of the matrix of the VECM that determines the number of independent co-integrating vectors. If the matrix Π has a rank, r, greater than 0, then co-integration exists. If the rank of Π is 0, then the variables are segmented and the model translates into a standard VAR model in differences. After going all these stages VECM was employed in this study.

3.5.5 Assessment of the economic performance of the major supply chains

According to Lambert and Pohlen (2001) a well-defined supply chain measurement system increases the chance for success by aligning processes across multiple firms, targeting the most profitable markets and obtaining a competitive advantage through lower costs. Likewise a lack of proper measurement system in the supply chain results in failure to meet consumer expectations, sub-optimization of company performance, missed opportunities and conflict in the supply chain. If farmers get disengaged from supply chain management, they run the risk of sabotaging partner strategy and customer relations for the long term. According to Neely (1998) performance measurement of supply chain is defined as a system that enables informed decisions to be made and actions to be taken because it quantifies the efficiency and effectiveness of past actions through acquisitions, collation, sorting, analysis, interpretation and dissemination of appropriate data. Measurement of the supply chain performance is important because it affects decision making through the evaluation of past behaviour and through the opportunity of benchmarking. Despite its necessity, there are still major issues in assessing supply chain performance. Lambert and Pohlen (2001) summarized the major issues in measuring the performance of supply chains as follows:

- The lack of measures that capture performance across the entire supply chain
- The requirement to go beyond internal farm measures and to go to supply chain perspective
- The requirement to align activities and share joint performance measurement information to implement strategy that achieves supply chain objectives
- The need to differentiate the supply chain to obtain a competitive advantage

Theodoras *et al.* (2005) added that evaluation of supply chain performance is complicated in the presence of multiple inputs and multiple outputs in the system. This implies that performance is multi-dimensional. The multi-dimensionality involves numerous

interdependencies and conflicts between the goals. The complexity of most supply chains makes it difficult to understand how activities at multiple tiers are related and impact each other. Another complexity that supply chains are facing is the conflicting goals of individual actors in the chain. Each individual actor has its own goals and optimization criteria. Conflicting interests of different actors in the chain complicates the availability of information. The relevance of information differs in each stage of the chain, even if information is of high importance for the overall supply chain performance. Moreover, the strategic value of some of information inhibits a free exchange between chain partners. Therefore, a well defined performance measurement system should give insight into the contribution of individual chain actors to the added value of the entire chain. In this study focus was on smallholder farmers.

To measure and compare the performance of supply chains an approach that incorporates multiple performance criteria was required. Different methods exist that can incorporate multiple performance indicators into one measurement system. Some of the best-known are the Supply-Chain Council's Supply-Chain Operations Reference (SCOR®) model, the Balanced Scorecard, Multi-Criteria Analysis, Data-Envelopment Analysis (DEA), Life-Cycle Analysis, and Activity-Based Costing (Aramyan *et al.*, 2006). The problem with respect to efficiency in supply chains is that beside direct outputs, which are delivered directly to the market, a firm also produces output that is input to a firm in the next stage. These intermediate outputs are intermediate inputs to the firm in the adjacent stage, next to the direct inputs. DEA allows inclusion of various dimensions, e.g. economic and environmental performance; therefore, it was employed in this study.

DEA is a linear programming-based and non-parametric technique for evaluating the relative efficiency of each member of a set of organizational units (Charnes *et al.*, 1978).The idea of DEA is to estimate a frontier that envelops all the input/output data with those observations lying on the frontier considered technically efficient. Thus, DEA measures the efficiency of a firm (chain) relative to the efficiency of competitors. DEA estimates a production frontier using information on inputs and outputs by enveloping the observed combinations of inputs and outputs. The envelopment technique implies that all best performers along the different dimensions are used to form the production frontier through local linear interpolation.

According to Zhu (2003) DEA has numerous modelling advantages. DEA takes a systems approach, which means that it takes into account the relationship between all inputs and outputs simultaneously. DEA generates detailed information about the efficient supply chain within a sample and identifies the supply chains that can be used as a benchmark. DEA does not require a parametric specification of a functional form to construct the frontier. Thus, there is no need to impose unnecessary restrictions on the functional forms that very often become a cause of distorted efficiency measures. However, DEA has the disadvantage of being a deterministic approach, which implies that statistical noise may be confounded with inefficiency (Zhu, 2003).

3.5.5.1 Constant Return to Scale and Variable Return to Scale Frontiers

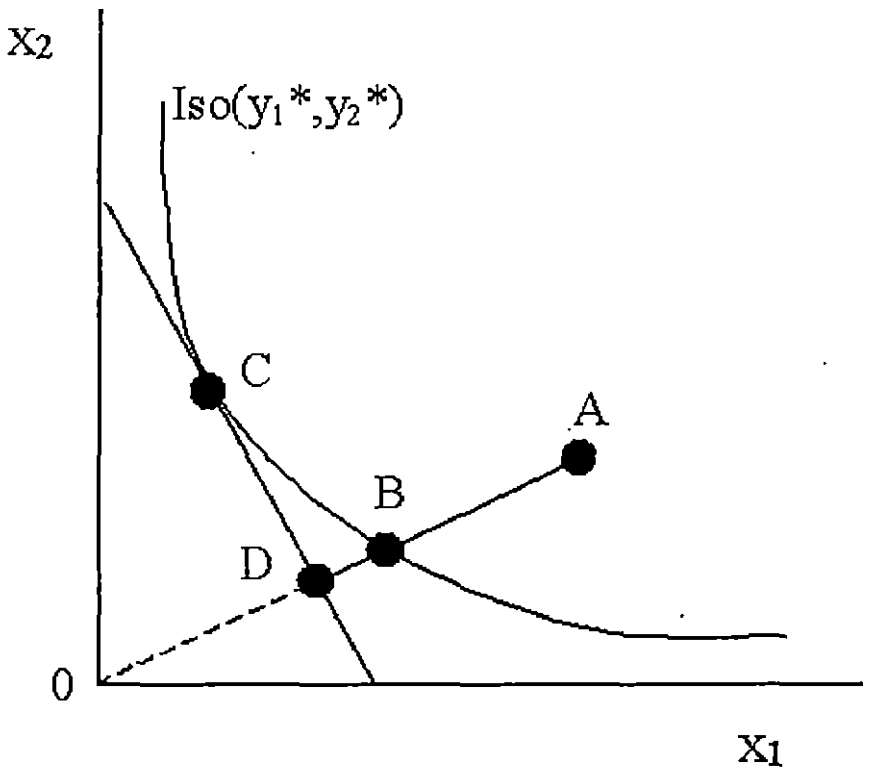
DEA was initiated by Charnes *et al.* (1978) with assumptions of constant returns to scale in the production process. Banker *et al.*, (1984) later proposed an alternative model that can handle more flexible cases of variable returns to scale. Since then, several contributions have developed versions of the DEA model. Thus, envelopment surface differs depending on the scale assumptions that underpin the model. Two scale assumptions are generally employed: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The latter encompasses both increasing and decreasing returns to scale. CRS reflects the fact that output will change by the same proportion as inputs are changed (e.g. a doubling of all inputs will double output) and VRS reflects the fact that production technology may exhibit increasing, constant and decreasing returns to scale. In technical terms, the model with variable returns to scale constructs the frontier as a convex hull of intersecting planes instead of the conical hull estimated by the constant returns to scale model (Fiorentino *et al.,* 2006). Hence, the variable returns to scale model envelops the data closer than the constant returns to scale model, a fact which implies that efficiency estimates are equal to, or greater than, those of the constant returns to scale model (Banker *et al.,* 1984). In this study, both conditions were assumed.

3.5.5.2 Input oriented measures

This study used an input-oriented approach, justified by the fact that smallholder farmers have a more or less fixed amount of output due to, e.g., contracts and greenhouse size. Therefore, they should be focused on minimizing the inputs necessary to producing a given bundle of output.

The input-orientated technical efficiency measure addresses the question: By how much can input quantities be proportionally reduced without changing the output quantities produced? In Figure 3.2 the farm is producing a given level of output (y1*, y2*) using an input combination defined by point A. The same level of output could have been produced by radially contracting the use of both inputs back to point B, which lies on the isoquant associated with the minimum level of inputs required to produce (y1*, y2*) (i.e. Iso (y1*, y2*)). The input-oriented level of technical efficiency (TEI(y, x)) is defined by 0B/0A. However, the least-cost combination of inputs that produces (y1*, y2*) is given by point C (i.e. the point where the marginal rate of technical substitution is equal to the input price ratio w2/w1). To achieve the same level of cost (i.e. expenditure on inputs), the inputs would need to be further contracted to point D. The cost efficiency (CE(y, x, w)) is therefore defined by 0D/0A. The input allocative efficiency (AEI(y, w, w)) is subsequently given by CE(y,x,w)/TEI(y,x), or 0D/0B in Figure 3.5.1 (Kumbhaker and Lovell, 2000). Technical efficiency was the focus of this study.

Figure 3.2: Input oriented approach



Source: Kumbhaker and Lovell, 2000

The mathematical specification of the input-oriented model where the inputs are minimized and the outputs are kept at their current levels is as follows:

$$\theta^* = \min \theta$$
subject to
$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io} \qquad i = 1,2,\ldots,m;$$
$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r = 1,2,\ldots,s;$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j \geq 0 \qquad j = 1,2,\ldots,n.$$

where,

$\square^*$ = the efficiency score of the DMU under analysis,

Y_r = the vector of outputs for DMU

n = number of DMUs under analysis;

λ (j = 1,2,...n) = the respective weights for output i and input r

(r = 1, 2,..., s) = possible outputs achievable by the DMU

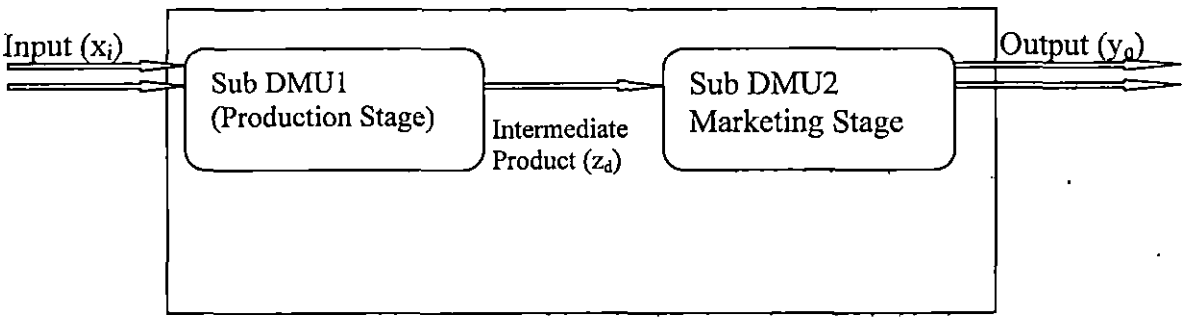
(i = 1, 2,..., s) = possible inputs achievable by the DMU (Banker *et al.*, 1984, Charnes *et al.* (1978)

Since DEA measures the relative efficiencies of organizations with multiple inputs and multiple outputs, the organizations are called the decision-making units (DMUs). DEA assigns weights to the inputs and outputs of a DMU that give it the best possible efficiency. It thus arrives at a weighting of the relative importance of the input and output variables that reflects the emphasis that appears to have been placed on them for that particular DMU. At the same time, though, DEA then gives all the other DMUs the same weights and compares the resulting efficiencies with that for the DMU of focus.DEA evaluates the efficiency of a DMU relative to an empirical production possibility frontier determined by all DMUs under appropriate assumptions regarding returns to scale and orientation. The key constructs of a DEA model are the envelopment surface and the efficient projection path to the envelopment surface (Charnes *et al.*, 1978).

Following Lu (2006), the classical DEA model was extended to two-stage model as shown in Figure 3.3. The tomato supply chain was treated as a production and marketing operations.

The tomato producers are envisioned as the DMUs, with production stage as sub-DMU1 and marketing stage as sub-DMU2. In the first stage, producers use farmland, fixed inputs and managerial inputs to produce certain quantity of tomatoes (intermediate products), then at the second stage, these tomatoes will be sold at the market place to gain income. The first Sub-DMU consumes inputs x_i to produce intermediate products z_d. These, in turn, are the inputs to the second Sub-DMU, which are used to produce the DMU's final outputs yq. The advantage of the two-stage supply chain model is capable to evaluate the relative efficiencies of each DMU and each of its sub-DMUs in the supply chain.

Figure 3.3: Two stage supply chain mode



Source: Lu (2006)

3.5.5.3 Economic Efficiency

Farrell (1957) explicitly decomposed overall economic efficiency into components namely technical efficiency and allocative efficiency. Profit maximisation requires a firm to produce the maximum output given the level of inputs employed (technically efficient), use the right mix of inputs in light of the relative price of each input (input allocative efficient) and produce the right mix of outputs given the set of prices (output allocative efficient) (Kumbhaker and Lovell, 2000). Technical efficiency reflects the ability of the DMU to obtain maximum output from a given set of inputs or to minimize inputs to produce a given bundle of output; allocative efficiency is the ability of a DMU to use inputs in optimal proportions, given their respective prices and production technology. In this study emphasis was given to technical efficiency.

3.5.5.4 Scale efficiency

In this study, total technical efficiency was further decomposed into pure technical efficiency (TE under VRS) and scale efficiency (SE). Coelli (1998) suggested calculating SE as a ratio of TE (CRS) to TE (VRS). If SE = 1, the firm is scale efficient, i.e., its combination of inputs and outputs is efficient both under CRS and VRS. If SE < 1, then the firm operates at sub-optimal size. In this study input-based technical efficiency scores under (VRS) obtained under strong disposability (SD) of inputs. Strong disposability of inputs means that an increase in inputs cannot decrease i.e. congests the output (Fare and Grosskopf, 2004).

3.6 Factors influencing market choice

Farmers, just as they are price-takers, also are channel-takers. They may have an opinion about which actor gives the highest price, which actor provides the best technical assistance but in the end it will be the buyer who decides whether he/she wants to buy produce from a particular farmer. To get a better insight into the socio-economic factors that might influence the farmer participation in different market channels and the extent of influence, a Random Utility Model was employed.

3.6.1 Random Utility Model (RUM)

Random utility models (RUMs) are well-established methods for describing discrete choice behaviour. RUMs or discrete models describe, explain and predict choices between two or more discrete alternatives. Marketing researchers use discrete choice models to study consumer demand and to predict competitive business responses, enabling choice modellers to solve a range of business problems, such as pricing, product development and demand estimation problems (Villas-Boas and Winer, 1999). In this section, the study considers the situation in which farmers choose one market from a set of two markets. First assumption is that choice is a discrete event. What it means is that choice is all-or-nothing. Farmers, as a rule, cannot participate in two market channels at a time. They participate in market 1 or 0 other markets. Thus choice is not a continuous dependent variable. Second assumption is that the attraction or utility towards the market varies across individuals as a random variable. In any case, second assumption is all about the word random in the label random utility model. The last assumption is that the farmer chooses the channel with the highest utility. This makes farmer an economically rational being.

The RUM or discrete choice models can be derived from utility theory. U_{ni} is the utility (or net benefit or well-being) that person n obtains from choosing alternative *i*. The behaviour of the person is utility-maximizing: person n chooses the alternative that provides the highest utility. The choice of the person is designated by dummy variables, y_{ni}, for each alternative:

$$y_{ni} = \begin{cases} 1, & \text{if } U_{ni} > U_{nj}, \quad j \neq i, \\ 0, & \text{otherwise} \end{cases}$$

Consider now the researcher who is examining the choice. The person's choice depends on many factors, some of which the researcher observes and some of which the researcher does not. The utility that the person obtains from choosing an alternative is decomposed into a part that depends on variables that the researcher observes and a part that depends on variables that the researcher does not observe. In a linear form, this decomposition is expressed as

$$U_{ni} = \beta z_{ni} + \varepsilon_{ni}$$

where, z_{ni} is a vector of observed variables relating to alternative i for person n that depends on attributes of the alternative, x_{ni}, interacted perhaps with attributes of the person, s_n, such that it can be expressed as

$$z_{ni} = z(x_{ni}, s_n), \quad \text{for some numerical function z,}$$

β is a corresponding vector of coefficients of the observed variables, and

ε_{ni} captures the impact of all unobserved factors that affect the person's choice.

The choice probability is then

$$\begin{aligned} P_{ni} &= Prob\ (y_{ni} = 1) = Prob\ (U_{ni} > U_{nj}, j \neq i) \\ &= Prob\ (\beta z_{ni} + \varepsilon_{ni} > \beta z_{nj} + \varepsilon_{nj}, j \neq i) \\ &= Prob(\varepsilon_{nj} - \varepsilon_{ni} < \beta z_{ni} - \beta z_{nj}, j \neq i) \end{aligned}$$

Given β, the choice probability is the probability that the random terms, $\varepsilon_{nj} - \varepsilon_{ni}$ (which are random from the researcher's perspective, since the researcher does not observe them) are below the respective quantities $\forall_{j \neq i}$: $\beta z_{ni} - \beta z_{nj}$. Different choice models arise from different

distributions of ε_{ni} for all i and different treatments of β. RU models can also be classified according to the number of available alternatives.

* Binomial choice models (dichotomous): 2 available alternatives
* Multinomial choice models (polychromous): 3 or more available alternatives. Multinomial choice models can further be classified according to the model specification:
* Models, such as standard logit, that assumes no correlation in unobserved factors over alternatives
* Models that allow correlation in unobserved factors among alternatives

According to Hair *et al.* (1998) there are many RUMs namely the logistic regression model, the probit model and the discriminant analysis, to mention but a few.

For the purposes of this study, the logit model was employed. The easiness with which the logistic model can handle qualitative dependent variables makes it more preferable over the other techniques. In addition, logit model was used instead of other models because it can handle categorical independent variables easily, whereas in discriminant analysis the use of dummy variable creates problems with the variance/covariance equalities. In addition, other models rely strictly on meeting the assumptions of multivariate normality and equal variance-covariance matrices across groups (assumptions that are not met in many situations). Logit model does not face these strict assumptions and is more robust when these assumptions are not met, making its application appropriate in many situations. Logit model allows for explicit testing of the impact of independent variables on smallholder farmer participation in modern agri-food markets.

The logit model belongs to the qualitative dependent variable methods and is a symmetric distribution which uses the latent variable approach to address the problem of heteroscedasticity since we have two values for the dependent variable. The functional form of the logistic model is given by;

$$F(zi) = \frac{\exp(zi)}{1+\exp(zi)}$$

$$= \frac{1}{1+\exp(-zi)}$$

where, $Z_i = \frac{P_i}{1-P_i}$, which is the ratio of the probability of success to the probability of failure known as the odds ratio. In the study P_i is the probability of participating in modern agri-food markets. In the case of smallholder farmers, Z may be interpreted as the farmer's propensity to participate in formal markets, with larger values of Z corresponding to greater probabilities to participate in formal markets. Logit model coefficients can be used to estimate odds ratios for each of the independent variable in the model. The model also assumes that Z is linearly related to the predictors, thus we have

$$\log \frac{P_i}{1-Pi} = Z_i = \beta_0 + \sum_{\forall i} \beta_i X_i$$

Where X_i is the i^{th} predictor case and b_i is the i^{th} coefficient. The model can be used to derive estimates of the odds ratios for each factor to explain how much more the independent variables is likely to participate in formal channels than non-cooperative member. If Z were observable, one would simply fit a linear regression to Z and be done. However, Z is unobserved, hence one must relate the predictor to the probability of interest by substituting for Z as follows;

$$F(z) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{i1} + \ldots\ldots + \beta_P X_{ip})}}$$

In this study the model puts forward that smallholder farmers from the survey were divided into two categories based on the type of markets which they supplied the greater percentage of their tomatoes, either formal or informal markets. It could be modelled as Pr (Y=1) if the farmers supply formal channel markets or Pr(Y=0) if otherwise. The underlying assumption is that the farmer chooses one of the two marketing channels in order to maximise his net benefits, given a set of constraints. The probability of participation in formal channels is expressed as Pr (Y=1) =F (x_{ij}), where xij is a vector of observed exogenous variables representing specific field and specific farm household characteristics.

There are a number of factors that might influence the market choice decisions which are shown in Table 3.1. First of all the education level of the farmer might influence this choice. The more educated a farmer is, the higher the chance the producer will receive a good

quality. The second factor that could influence the choice is the number of years a person is a farmer. The more experience a farmer has, the higher the chance that he will produce a good quality. The size of the farm could also have an influence. The larger the farm, the better equipped the farmer could be to supply to a lucrative chain. Also the amount of tomatoes produced per acre might be a significant factor. The more kilograms a farmer produces per acre, the more willing the formal market is to buy from him. The other determinants that could have an influence have to do with the buyer requirements are such as quality, and time, contracts, social capital, trainings, tomato price, market risk, and gender.

Table 3.1: Variables fitted in the RUM model

Variables	Unit	Type of variable
Dependent variable		
Market type	Farmers sell to	1 if formal channel ,0 if otherwise traditional channel
Independent variables		
Age	Number of years	Continuous
Gender	Male/female	Binary (0,1)
Farming experience	Years in farming	Continuous
Farm size	Arable ha	Continuous
Training	Did you receive agricultural training?	Binary (0,1)
Labour size	Total labour used per season *(hired + family members)*	Continuous
Cooperative member	Membership to a input/output marketing cooperative	Binary (0,1)
Market information	Access to real time market information	Binary (0,1)
Greenhouse	Access to a greenhouse	Binary (0,1)
Quantity supplied	Quantity supplied to the market	Continuous
Distance	Distance to the market	Continuous
Extension	Receive enough extension	Dummy
Production cycle	Production cycle	Continuous
Credit	Access to real time market	Binary (0,1)

However, it was necessary to make sure that there was no problem of endogeneity due to reverse causality between dependent and independent variables. A loop of causality between the independent and dependent variables of a model leads to endogeneity. For example, when the farmers access formal markets before being a cooperative member, the cooperative member is endogenous because their cooperative membership can be influenced by their participation in formal markets. In contrast, a cooperative membership can influence market accessed when producers become members before participating in formal markets. The presence of endogeneity causes the regression coefficient in an Ordinary Least Squares (OLS) regression to be biased. There are many methods of overcoming this, including control function method and vprobit regression. However, in this study after data collection it was found that all farmers who were cooperative members joined cooperatives before participating or never participated in the formal markets. Accordingly, it was concluded that independence assumption holds and the problem of endogeneity was ruled out.

3.7 Institutional Innovations

Many arguments have been given supporting the relevance of using institutional innovation platforms as a tool to achieve objectives set out by a multi-stakeholder community wanting to develop agri-food value chains. However, there is still very little research published on the impact assessment of institutional innovation platforms. According to International Food Policy Research Institute (IFPRI, 2009) it is important to carry out institutional analysis with respect to innovations, addressing questions that include the following:

- How do innovations come about?
- Which actors are involved in the innovation system and what roles do they play?
- What are the rules that guide the behaviour and practices of actors?
- How are smallholder farmers engaged?
- What are the relative benefits of institutional innovation to the farmer (efficiency, inclusiveness and sustainability)?

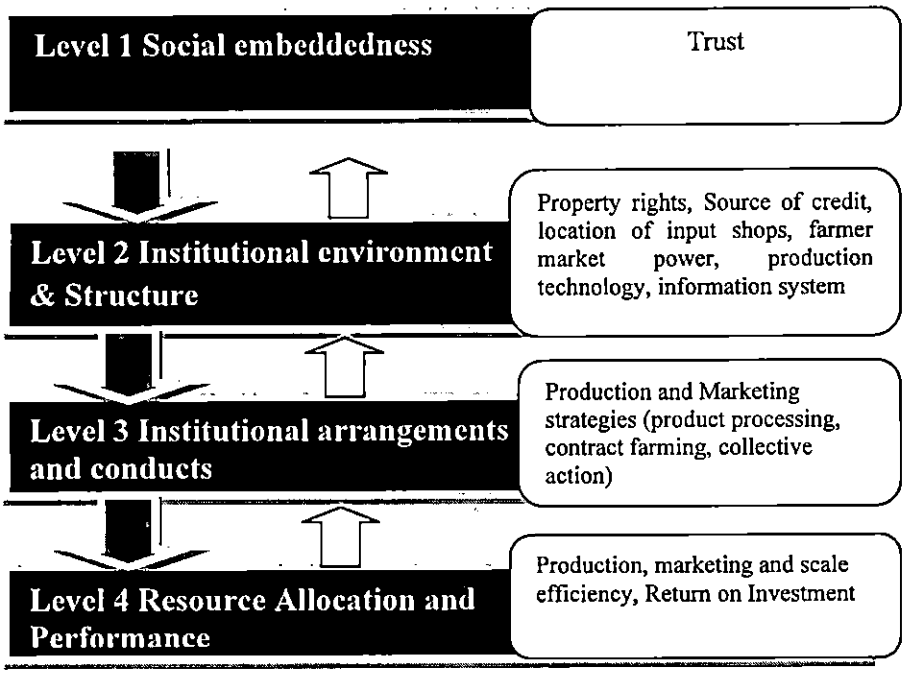
Therefore, these were the questions used in this study for each form of innovation. Following Milagrosa (2006)'s work, two analytical approaches were combined into one structure in order to obtain a deeper insight on institutional economic nature of tomato production and marketing. Specifically, the Structure-Conduct-Performance (SCP) approach was embedded within Williamson (2000)'s Economics of Institutions framework.

3.7.1 Integrated New Institutional Economics - Structure-Conduct-Performance framework

According to Milagrosa (2006) although elements of the different levels of Williamson's Economics of Institutions possess similar attributes with elements in the Structure Conduct Performance framework, the two are not one and the same. The main focus and therefore, the main results of each level of Williamson's paradigm are substantially different from the focus and findings of the SCP approach. Hence, independently, the two elements already provide a strong theoretical and methodological approach to analysing the tomato production and marketing sector. However the two approaches were combined for a reason, putting the two frameworks together in one single schema provides deeper insight via reciprocal approaches' findings validate each other but also at the same time, supplement in the analysis where the other method is deficient in. In short, incorporating the two approaches into one allows a more thorough analysis than using them singularly.

As illustrated in Figure 3.4, the SCP paradigm is combined with Williamson's Economics of Institutions approach in order to create one framework. Specifically, analysis of the structural aspect was combined with the institutional environment level. Conduct is situated in the governance structures level while performance is brought into the resource allocation level. Similar to the framework of Williamson, the downward moving arrows mean that the higher level influences the lower levels while the upward moving arrows indicate that there is feedback in the system.

Figure 3.4: Integrated New Institutional Economics - Structure-Conduct-Performance (SCP) framework



Source: Milagrosa (2006)

3.7.1.1 Analysis at Level 1: Social Embeddedness

Social embeddedness is located at the highest level and refers to customs, traditions and societal norms (Williamson, 2000). Changes in social embeddedness occur at rates of centuries to millennia and consequently the level of social embeddedness often is taken as it is given (Williamson, 1998). The level of social embeddedness can be analysed using social capital theory (Williamson, 2000). It is acknowledged that social capital is an important factor behind economic development since trust, norms and networks boost economic and institutional machinery (Beugelsdijk and Schaik, 2001). It has also been argued that long-term economic development efforts hinge strongly on the levels of national, regional or local social capital (Ostrohm and Ahn, 2001). Social capital consists of observable but non-contractual elements such as trust, shared norms and social networks (Milagrosa, 2006). Putnam (1993) defines social capital as being features of social organisation (for example trust, norms and networks) that can improve societal efficiency by facilitating coordinated action. Other elements also include volunteerism, reciprocity, associatedness, formal and informal organisation, traditions and beliefs. Of all of these elements of social capital, trust is

argued to be the most important, since trust can make people go beyond the requirements of the contract, through early delivery, higher quality or some other means, to support their good intentions and sustain trust (Milagrosa and Slangen, 2005). Thus, in this study social embeddedness was analysed using social capital theory.

From the literature it seems that measuring social capital proves to be a challenge. Milagrosa (2007) provides three possible reasons for the difficulty in measuring social capital. Firstly, she argues that social capital perceptions are highly subjective and it is difficult to narrow down the subtleties of the population and to reduce the value of connectedness of a community to a number (Milagrosa, 2007). The second reason centres around the fact that social capital is extremely dynamic and volatile since social capital dissolves once the ties between participants are broken. Social capital also needs to be renewed and used continuously otherwise its level will decrease.

Despite of the challenge of measuring social capital, various approaches have been used to measure it (Milagrosa, 2007). However, no standard measure of social capital can ever be achieved since the respective measurements are dependent on the definitions employed by the researchers (Milagrosa, 2007). Milagrosa (2007) concludes furthermore that no single approach is superior to another. In this study, social capital is analysed in the form of trust shared in the tomato farming communities of Mashonaland east. Since trust cannot be measured effectively with a single question, as it is a complex mental condition. Following a study by Butler (1990) six elements were used to calculate interpersonal trust value among supply chain actors which include, capability, commitment, consistency, willingness to invest, willingness to examine assumptions and willingness to risk. Respondents were directly asked about their level of trust with regard to other actors in the supply chain. The elements were rated with respect to the degree of trust on a five-point Likert scale (1 = not at all 5 = yes, indeed). The level of trust among different actors in the chain was assessed. Since the ratings ranged from 1 to 5, the dataset had been normalized using a linear operation to compress [1; 5] to [0; 1] to stop farmers assigning arbitrarily high trust values to other farmers, as well as arbitrarily low values. For this, a normalized local trust value: (cij) was expressed as follows:

$$Cij = \frac{max\ (s_{ij}, 0)}{\sum_j max(s_{ij}, 0)}$$

thus ensuring that all values will be between 0 and 1. Hence, trust in this model is represented by a value from continuous interval (0, 1).The algorithm then aggregates these trust values: actors *i* asks its neighbours about their opinions about other peers, and then weights these opinions by the trust peer *i* has in them:

$t_{ik} = \Sigma j\ c_{ij}c_{ik}$.

The reliability of the scales was estimated using Cronbach's alpha. To interpret the Cronbach's alpha, the study follows the rule of thumb provided by George and Mallery (2003): > .9 (Excellent), > .8 (Good), > .7 (Acceptable), > .6 (Questionable), > .5(Poor), and < .5 (Unacceptable).

3.7.1.2 Level 2: Institutional environment and structure

At the second level of analysis is the institutional environment. The institutional environment consists of both the formal rules and informal constraints that regulate the way transactions are conducted (Williamson, 2000). These define the rules of the game (North, 1991; Williamson, 1998). The rules in the institutional environment aim at facilitating the economic transactions and have to be respected by all actors in the market (Hai, 2003). The institutional environment plays a significant role in shaping events at the downstream or governance level. With good institutions, a more favourable environment supporting economic growth is created. Well-organized institutions translate into good governance structures (Slangen *et al.*, 2004). Good institutions and good governance structures contain efficient information transfer mechanisms that result in appropriate decisions among parties involved. Economic development and good institutions are mutually occurring reciprocal phenomena. On the one hand, economically developed areas demand for and contribute to good institutions. On the other hand, a good institution creates economic development. Actors involved in the production and marketing of agricultural products need protection against opportunistic behaviour.

In relation to the study area, the institutional environment refers to the rules of how tomato exchange was conducted. Farmers and traders need protection from the local government to hedge against trader opportunistic behaviour. Most interventions are price and pricing strategies although some extend into rules and regulations governing transactions. The types of protection mechanisms and the manner in which government arranges those mechanisms

are translated into the formal rules of the institutional environment (Milagrosa, 2007). Formal rules encompass a variety of concepts, these consist of private and public orders, constitutions, laws, policies, regulations and property rights issues (North, 1994). The formal rules have the purpose to ensure that transactions are conducted in an efficient manner from society's point of view. These formal rules and regulations are nowadays even more important than ever since more agricultural producers are linked to consumers and corporations. Those consumers not only demand choice, they also want quality, consistency and value (Kherallah and Kirsten, 2002). In order to supply agricultural produce to such buyers, producers have to meet the requirements specified in the formal rules and regulations at the institutional level.

As formal rules, property rights have a major influence on the way transactions are conducted. Slangen *et al.* (2004) argue that property rights over land and water are probably the most important formal rules in agriculture. The importance of property rights centres on the fact that externalities can be internalised if property rights are well-established (Coase, 1937). Property rights refer to formal and informal rules that determine access to assets, both tangible (i.e. land, water, buildings, etc.) and intangible (i.e. contract rights, patents, etc.), and also the way those assets can be used (Herrera, 2005). The property rights give the holder of those rights the right to derive value from the asset by using it as he sees fit, to exclude others from using the asset, and to transfer the ownership of the asset to another party. Property rights thus give the holder of the rights an incentive to invest in the underlying asset.

The incentive embedded in property rights depends on the level of individualisation of ownership of the property right. The individualisation of ownership of the property rights can be expressed along a spectrum (Herrera, 2005). Open access refers to the absence of exclusive rights (anyone Literature review and development of conceptual framework can use the resource as he likes) and lies at the one end of the spectrum. The other end of the spectrum is private property, which gives the holder exclusive decision-making power. Between private property and open access, there are also common property and state property. Common property refers to the situation where a collective entity (e.g. a co-operative group) owns the decision-making power, while state property refers to the situation where the government has the decision-making power (Herrera, 2005). Herrera (2005) argues that the lack of individual decision-making power serves as a disincentive for an individual to

invest in the underlying asset. Within the South African context, the rules and regulations associated with the land tenure systems that apply at smallholder irrigation schemes are crucially important.

Structure at this level refers to the characteristics of the market or industry that have a strategic influence on the nature of competition and pricing within the market (Allen *et al.*, 1999). The structure component of the SCP can be separated into farm-structure and market structure. Farm structure refers to the physical characteristics of the region, the distribution of land within the region, and also land ownership and tenure (Milagrosa, 2007). The characteristics of the region that are of importance include the specific location, its topography, the size of the population in the region, the proportion of the population involved in agriculture, the main crops produced in the region, and the total land area in the region. Land distribution is concerned with the number of farmers in the region, the average size of farms and also the distribution of farm sizes. Finally, farm structure is concerned with the different systems of land ownership and tenure that exist in the region under consideration. The number of farms related to the respective tenure systems, as well as the distribution of land under the respective tenure systems, are of importance (Milagrosa, 2007).

Market structure is generally concerned with the characteristics of the organisation of a market which seem to influence strategically the nature of the competition and pricing within the market (Bain, 1951). Hai (2003) considers the degree of market concentration, the degree of product differentiation, the existence of entry and exit barriers, and the distribution of power when assessing market structure. When assessing market structure, Caet (2001) considers the different types of markets that are available, the different marketing channels, and all the actors who are involved in moving the physical product from the farm to the final consumer. Milagrosa (2007) also considers the location of the input and product markets, the market infrastructure, the availability and condition of road networks to and from the farms. According to the developed conceptual framework, the farm and market structure is also influenced by rules and regulations that are included in the institutional environment of the NIE component in the framework. Thus, the following[1] variables were selected for

[1] Selection of the variables to be included in the assessment of the impact of institutional innovation on value chain was guided by FOA (2012) and Milagrosa (2006) frame work.

institutional innovation analysis at this level: Product differentiation (processing), source of credit, location of input shop and conditions of road networks to the market from the farm.

3.7.1.3 Level 3: Governance structures and conduct

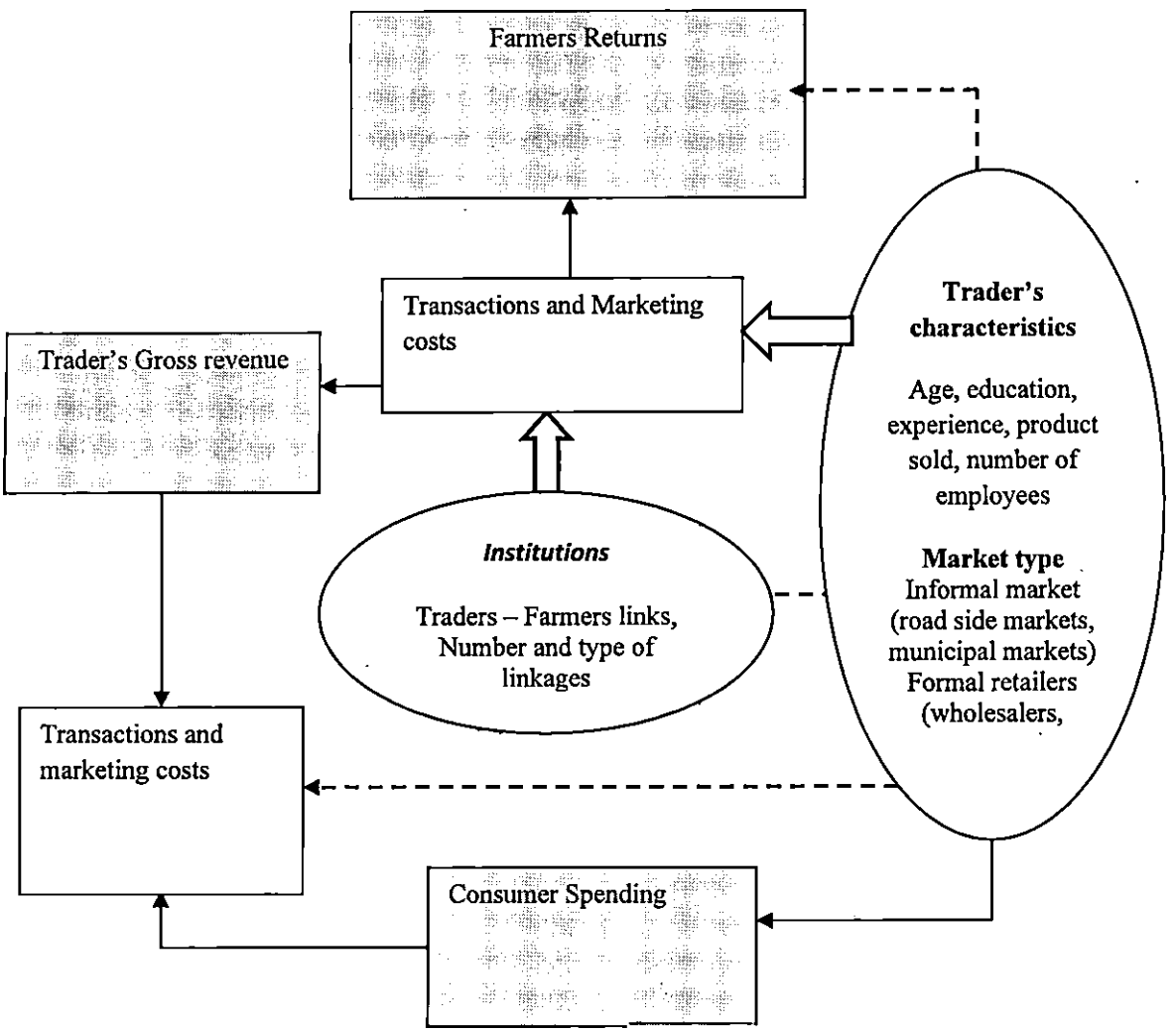
The question that directly refers to this level is: What are the existing marketing arrangements and governance structures in tomato markets? The institutional arrangements or play of the game is at the third stage of social analysis in the framework. The institutional arrangements are the ways of putting into action the framework for operations outlined by the institutional environment. Ménard (1997) defines it as ways to implement and operationalise the rules of the game as defined by the institutional environment. To determine which contract type is optimal for a transaction, three transaction characteristics must be noted: asset specificity, frequency and uncertainty.

Asset specificity relates to the amount of money, time and effort put into the transaction by the transacting parties. Degree of asset specificity is a good measure of the vulnerability of the investing party to opportunism. The bigger and more specific the investments of one party are the more vulnerable the investor is to opportunistic behaviour, hold-up and sunk costs (Verhaegen, 2001). This is particularly true when the investment is highly specific or has few alternative values. Opportunistic behaviour occurs in cases when one party highly depends on another's products as necessary inputs for his production process or when one party invests on specific technologies at the behest of their transacting partner. In the first case, the dependent party may be exposed to opportunism when the other party refuses to meet the agreements unless a new more advantageous agreement has been renegotiated in his favour. This results in the other party being held up because production cannot continue without the necessary input and time is short to look for another governance structure. In the second case, when the trading partner refuses to transact, the investing party is left with huge financial liability. One party becomes vulnerable to opportunism because of a special investment in a technology that is useful for a specific purpose (and often times), for specific governance structure only. To prevent opportunism, a special contract is necessary. Frequency relates to the recurring nature of the transaction over time (Verhaegen, 2001). Transactions could be occasional or recurrent. Verhaegen and van Huylenbroeck (1999) argued that recurrent transactions would lead to routines between transacting parties, a decrease in transaction costs and fewer incentives to act opportunistically. Most importantly, determining the optimal

governance structures leads to transaction cost economising results. This means that the cost of doing the transaction would be minimised.

The study adopted the Institutional Analysis and Development (IAD) conceptual framework suggested by Dorward and Omamo in Kirsten and Vink (2005) at this level (Figure 3.8). The framework was used to analyse the nature of supply chain relationships between supply chain actors and smallholder farmers. It enables one to analyse and explain the different strategic interactions between two parties (farmers and traders), given the set of expected asymmetries of information and transaction costs that they are facing.

Figure 3.5: Farmer-trader linkages: An institutional framework



Source: Temu (2007)

Arrows indicate direction of influence

Conduct at this level refers to the behaviour of the agents within the farm and market structure. Conduct can be divided into production and marketing conduct (Milagrosa, 2007). Production conduct is concerned with the cropping practices of the producers under consideration, the farming techniques used and the sources and availability of credit to those producers. Although the conceptual framework also allows for a comprehensive analysis of the conduct of the support structures, the conduct of the support structures is only considered to the extent to which it influences the behaviour of the farmers from Mashonaland East. Market conduct, on the other hand, refers to the set of competitive strategies (cooperatives, contracts and informal farmers' group) that a trader or a group of traders use to run their businesses (Hai, 2003). When assessing marketing conduct, the aspects to be considered include the sources and availability of market information, the method of price formation, investment in new technology, research and development of new products, investment in technical training and services, the level of competition in the market, the types of contracts that are employed and the marketing strategies that are used (Milagrosa, 2007). As a result the following variables were selected for institutional innovation analysis at this level in this study: production and marketing strategies (collective action, contract, vertical integration (internal expansion).

Collective action was used to assess formal or informal farmer based organisations. According to Sandler (1992), collective action arises when people collaborate on joint action and decisions to accomplish an outcome that involves their common interest or well-being. Marshall (1998) defined collective action as the action taken by a group (either directly or on its behalf through an organization) in pursuit of members' perceived shared interests. As observed by Meinzen-Dick *et al.* (2004), the more specific and varied definitions which have been added later have in common the following features: the involvement of a group of people, shared interests, common and voluntary actions to pursue those shared interests. In this study collective action was considered under different organizational forms, such as informal farmer-based organizations and formal agricultural cooperatives. A very relevant issue to consider when analysing the dynamics of collective action is what type of organization has developed and/or supported such action. In many cases the outcomes of the collective action are highly dependent on the type of organizations involved, but also to the institutional arrangements which are in place at the local level. In the agricultural realm, for example, it is necessary to distinguish whether the collective action is developed by an

organization directly controlled by farmers or if it is controlled and supported by a national/regional governmental authority. Davies *et al.* (2004) distinguish two types of collective action: (i) cooperation: bottom-up, farmer-to-farmer collective action and (ii) coordination: top-down, agency-led collective action. While some bottom-up collective actions may receive government support, others may be carried out without government support. Similarly, some top-down collective actions are promoted by government policies but do not receive any support, while other collective actions receive support by local and/or government. Although there are many instances in which individuals would be better off if they cooperated, collective action often does not emerge. Problems typically arise over imbalances among contributions to the effort and the distribution of benefits from the creation of public or collective goods, known as the free-rider problem, thus this section looks at the problems faced by farmers under different types of collective actions and impact on accessing markets.

Following Ponnussamy and Swathilakshmi (2011)'s work, the identification of major problems was done through Preferential Ranking Technique which involves the following steps

1. Identification of key informants (KI): Key informants, who were conversant with the existing situations, like extension officers from Ministry of Agriculture, Non-governmental organisation involved in irrigation activities. KIs were requested to rank possible reasons from 1 to 9.
2. Formation of farmers groups from irrigation cooperatives understudy: Ten farmer groups were identified with the help of KIs and responses were taken in a similar way. The farmers from each group were assisting each other to rank major reasons as one respondent.
3. Quantification of data: Rank Based Quotient (RBQ) was calculated for each reason both for KIs and farmer groups with the formula: $RBQ= \Sigma[F(n+1-i)/Nn]*100$

where, Fi is the frequency of youths or KI for the ith rank of reason; N and n denote the total number of respondents and total number of possible identified reasons, respectively. To choose a single RBQ value for each reason between KIs and farmer groups, rank correlation (R) coefficient was computed to know the degree of association between their rankings which is as follows: $R= 1- (6 \Sigma d_i^2 / n^3-n)$

where, *d* is the difference in the ranks between the key informants and farmer groups for the *ith* reason; n is the number of possible reasons. If the R-value is significant at 5 per cent level, the average RBQ value was taken; else RBQ value of the farmer groups was taken as final one.

3.8.3.4 Financial flow performance of collective action

This section assesses the interrelationship among farmers' performance, which affects the entire group and threatens sustainability of the collective action. The contractual terms define the expected time for customer/farmer payments. The financial flow performance measurement was employed for analysis. The normalised value of financial flow performance was calculated as follows:

$$NFP = \frac{\sum_{t=1}^{j} APt * (1 + r)^{(ET_i - T_i)}}{\sum_{t=1}^{j} APt}$$

where,

j – number of payments

AP_i – actual payment

ET_i – expected payment time

T_i – actual payment time

r – discount factor

If NFP is greater than one, it means payments are made on time and if NFP is less than one, it means some payments are delayed and can threaten sustainability of the group. The discount factor (r) is a key variable of this process, so its section is crucial.

A firm's weighted average cost of capital (after tax) is often used, but many people believe that it is appropriate to use higher discount rates to adjust for risk or other factors. A variable discount rate with higher rates applied to cash flows occurring further along the time span might be used to reflect the yield curve premium for long-term debt.

Another approach to choosing the discount rate factor is to decide the rate which the capital needed for the project could return if invested in an alternative venture. If, for example, the capital required for Project A can earn 5 per cent elsewhere, use this discount rate in the NPV calculation to allow a direct comparison to be made between Project A and the alternative. Related to this concept is to use the firm's Reinvestment Rate. Reinvestment rate can be defined as the rate of return for the firm's investments on average. When analyzing projects in a capital constrained environment, it may be appropriate to use the reinvestment rate rather than the firm's weighted average cost of capital as the discount factor. It reflects opportunity cost of investment, rather than the possibly lower cost of capital. This is the criterion which was employed in this study.

3.8.4 Level 4: Resource allocation and performance

The fourth and final level of the NIE-SCP framework is concerned with the allocation of resources and employment (Williamson, 1998). At the level of resource allocation, market performance is evaluated with special reference to the quantities produced and marketed, production and marketing costs, and price analysis in the form of farmer's and traders' share of total market sales (Milagrosa, 2007). Level 4 is analysed with neoclassical economic theory where the firm, again, is described as a production function (Williamson, 2000) rather than a governance structure. Neoclassical economics is thus concerned with the allocation of resources in an optimal manner, which is the level where profit and/or utility are maximised. The importance of efficiency to economics is centred on the scarcity of resources.

3.8.4.2 Assessment of resource allocation and performance

The study of performance deals with the state of reality that is achieved by an industry and refers to economic results (Hai, 2003). The performance component of the SCP analysis is concerned with the actual volumes of the tomato that was produced, the sales, costs and income earned by the respective agents along the supply chain. The conceptual framework also captures the link between the resource allocation level of NIE and performance. The degree of efficiency with which production inputs are used has a direct influence on the performance of the farmers under consideration. A number of tools were used for analysis at this stage, which are given below.

In order to assess resource allocation and performance production efficiency and marketing efficiency were computed from farmers' point of view. To measure and compare the resource allocation and performance an approach that incorporates multiple performance criteria is required. Thus, DEA was employed for analysis. These measures are used to investigate the factors associated with technical and allocative efficiency.

Return of Investment (ROI)

ROI was also assessed at this level. Per cent is an easy measure to compare. A simple way to calculate ROI is by dividing gross margin by cash costs. It is the rate of revenues received for every dollar invested in an item or activity. It is used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. The difference with ROI is that the farmers will get an idea of how profitable their business would be based on the investments they can make. The farmers will be able to know how much do they get per every dollar invested in production and marketing. A higher ROI means that investment gains compare favourably to investment costs. Land efficiency was expressed in terms of percentages as compared with the average yield of the locality. Average yield of locality was given by the government.

RESULTS AND DISCUSION

4. RESULTS AND DISCUSSION

The results of the study are presented in main seven sections viz.

4.1 Characterisation of smallholder farmers

4.2 Socio-economic factors influencing market choice

4.3 Identification of supply chain

4.4 Price behaviour

4.5 Economic performance of supply chain

4.6 Institutional innovations

4.7 Viable supply chain

4.1 Characterisation of smallholder farmers

This section presents a comparative analysis of the socio-economic characteristics of smallholder farmers using survey results. The section describes types of household head, number of years in vegetable farming, and level of education. In addition, it also covers size of household, level of ownership of assets such as cattle, pumps, land size and trucks and market channel of their choice. The preliminary analysis aims at characterising the typology of farmers and assessing if there are any significant differences in socio-economic characteristics possessed by farmers. The farmers were grouped into two groups depending on the type of markets they access. The markets were labelled as informal and formal markets.

4.1.1 Informal and formal markets

The market for small scale tomato farmers is characterised by a dual system, the informal market and formal market. It is known as informal market because there is large number of players involved who are neither taxed nor enumerated and transactions are not written down making traceability difficult. However, food and agricultural product markets, predominantly in developing countries, have undergone tremendous changes in the past decades (Swinnen and Maertens, 2007). There has been a shift from public to private food standards in response to consumer concerns about food safety, quality and the socio-economic and environmental conditions of production. On the consumer side, the quest for variety and convenience has led

to greater product differentiation and market segmentation. On the supply side, food processors and retailers have introduced quality assurance schemes for strategic reasons. As a result of restructuring, supermarkets, wholesalers and processors have become major actors in domestic food supply chains constituting formal markets (Reardon *et al.* 2007). Given these push-pull forces, the access of developing country producers, particularly smallholder farmers, to formal/modern agri-food markets such as supermarket, processor and wholesaler markets have been the focus of considerable attention (Reardon and Berdegue, 2002).

4.1.2 Household head and size

Table 4.1 shows distribution of households according to the type of household head. Approximately 58.33 per cent of all households was considered to be male headed, 40 per cent female-headed and 1.67 per cent child headed households.The survey results showed that male headed households were majority in both informal markets (61.25%) and formal markets (52.5%). De jure female headed households (women whose husbands have migrated away in search of employment) were second from male headed households in both informal markets (25%) and formal markets (35%). De-facto female headed households (includes widows, divorced women, single women, abandoned women) were almost equal in informal market and formal market. This shows that female-headed households to be disproportionately represented in the agricultural markets. This is consistent with literature as it is often suspected that female-headed households are poorer than male-headed households as are less able to invest and participate in markets (World Bank, 2001). Women spend almost twice as much time as men undertaking housework, completing household chores for which they are not remunerated. In addition, the results indicated that all child headed households participated in the informal market.

Table 4.1: Type of the household head

Household head	Market type			
	Informal Markets	Formal Markets	Total	t-test
Male headed	49(61.25)	21(52.5)	70(58.33)	6.16
Female de-facto headed	9(11.25)	5(12.5)	14(11.67)	
Female de-jure headed	20 (25)	14(35)	34(28.33)	
Child headed	2(2.5)	0(0)	2(1.67)	
Total	80(1000	40(100)	120(100)	

Source: Survey, 2013 Figures in parenthesis show percentage

Table 4.1 shows that the number of male headed households that participated in the formal agri-food market was significantly different from the number that participated in the informal market at 5 per cent level (t-test=6.16). Similarly, significant difference (3.204) was observed in households that fell under de-facto-female headed household. The overall scenario shows that at 5 per cent level, the number of smallholder farmers who participated in the formal market was significantly smaller than the number that participated in the informal market.

The results indicated that the minimum number of household members was 2. The informal market participants had the maximum number of family members which stood at 8 whilst formal participants had maximum number of 7 family members. The average size of household for informal market (5.3) was bigger than that for formal agri-food market participants (4.5). The *Z*-value (3.92) was greater than 1.96 which indicated that the difference between family sizes of the two groups was significant. The results were inconsistent with census results found in 2012. Zimbabwe National Statistics Agency (Zimstat, 2012) found that the country's average household has fallen from 4.4 since 2002 to 4.2 persons per household and in Mashonaland east Province the average household size is 4.0. About 75 per cent of households were composed of half economic active members and noneconomic members. According to Zimstat (2012) in 2002 47 per cent of the economically active population was listed as smallholder farmers, while the latest figures published in 2012 showed a negative 10 per cent movement to 37 per cent. Conversely those active elsewhere (other employed) have grown by 12 per cent from 40 per cent in 2002.

4.1.3 Age and experience

Table 4.2 shows the age descriptive statistics of respondents who either participated in formal or informal channels. The average age of formal market participants from the survey (42.25) was smaller than average age (46.6) of the informal market participants. Farmers from both groups were of age group between 20-65 years although two respondents from informal market fell within the age group of teenagers. About 10 per cent of formal market farmers was of age between 20-30 years, 40 per cent was of age between 30-40 years, 12 per cent was aged between 40-50 years, 7 per cent was aged between 50- 60 years and 1 per cent was over 60 years. Approximately 2.5 per cent, 12.5 per cent,13.5 per cent, 47.5 per cent, 25 per cent and 5 per cent of respondents who supplied their tomatoes to informal market was aged between 10-20, 20-30,30-40,40-50,50-60 and above 60 years respectively. The majority of respondents who participated in formal market fell within the age group of 30 - 40 whilst those who participated in the informal markets fell within the range of 40 to 50. The number of youths from informal market participants (7) and formal market participants (4) who were respondents in this study were almost equal. Although the total figure of youths looked to be small as compared to other age groups this could be a positive sign that youths were recognising farming as their main source of income. The *Z*-test was used to answer the following question: Is there any difference between the age means of respondents who either participated in the informal or formal markets? The Z value (2.03) was greater than 1.96, hence it was concluded that the age mean deference was significant. The results are consistent with some literature which shows that farm activities are greatly affected by age. Most supermarkets suppliers are relatively young farmers as they tend to be innovative entrepreneurs who produce in response to the supermarket demands (Kamau, 2008). Although the age mean difference was significant, experience mean difference (Z-test =1.48) was less than 1.96) between farmers who participated in the formal market and informal market was not significant. Hence, with regard to experience they had almost the same number of years in farming.

Table 4.2: Age and experience of farmers

Type of market	Average age				Experience			
	Min	Max	Mean	Z-test	Min	Max	Mean	Z-test
Informal	16	66	46.24		1	30	10.7	
Formal	25	65	42.3	2.03	2	20	9.0	1.48

Source: Survey data

4.1.4 Level of education attained by farmers

Table 4.3 shows the level of education attained by respondents. The results showed that the least level of education attained by respondents from both groups was adult literacy. The majority of the respondents from both formal market (62.5%) and informal market participants (65%) had attained secondary education. About 20 per cent of the total respondents had attained tertiary education and 41.7 per cent of them participated in the formal channel. Chi–square tests were conducted to assess if there was any significant association between market type and level of education attained. The results showed that there was no significant association between market type and level of education attained (chi square = 1.39, p = .708). In order to confirm the results (Chi-square results) phi coefficient was employed. Phi is interpretable as a nonparametric correlation coefficient, and means just the same thing as the Pearson r in terms of the strength and direction of the relationship between these two variables. In this case, phi = .108, which was a weak positive relationship between level of education attained and type of market supplied. The correlation was flagged as non-significant, with the same p-value (0.708) that was given for the chi square test. The results are inconsistent with the literature which shows that the higher education means more information on potential sources of credit for investment in farming and better management of credit facilities and ability to negotiate contracts, eventually participate in high value markets (formal markets). Hassine (2008) focused on the agricultural sector and found strong evidence that the level of education affects agricultural productivity growth and market access by increasing the capacity to adopt modern technologies. Hassine (2008) also indicated that educated farmers were able to understand the requirements of the contracts.

Table 4.3: Households distribution according to educational level attained

Level of education	Type of the market				Total	X^2 - test
	Informal market		Formal market			
	Frequency	Percentage	Frequency	Percentage		
Adult literacy	2	5	4	5	6	
Primary education	3	7.5	10	12.5	13	
Secondary education	25	62.5	52	65	77	
Tertiary education	10	25	14	17.5	24	
Total	40		80		120	1.39

Source: Survey data

4.1.5 Type of formal agricultural training received

Respondents were asked about the level of agricultural training they had received. Table 4.4 shows that the majority of the formal market farmers have received master farmer training (about 47.5%) while informal market participant farmers have mainly received on farm training (43.7%). Unlike respondents who participated in informal market, all respondents who participated in the formal market received certain level of agricultural training. The college level of agricultural training is low under both categories. The X^2-test (chi-square =.304, p = 0.026) showed that there was significant association between type of agricultural training received by the smallholder farmers and market type accessed. Level of agricultural training received by the farmers influenced the choice of market channel. The study found that 25 per cent of the farmers who participated in formal market were formally employed, 20 per cent had private business other than farming and 55 per cent comprised fulltime farmers. In the informal market, 2 per cent of the households were formally employed, 3 per cent had private business and 97 per cent were fulltime farmers. Since the results showed that there was insignificant association between level of education and market type but significant association between market type and formal agricultural training, hence, it's about receiving relevant training not education in general.

Table 4.4: Type of agricultural training received

Type of market	Level of agricultural training					
	None	Master Farmer	On farm	College	Vocational	Total
Informal	5(6.3)	25(31.3)	35 (43.7)	5(6.2)	10(12.5)	80
Formal market	-	19(47.5)	9(22.5)	7(17.5)	5(12.5)	40
Total	5(4.1)	44(36.7)	44(36.7)	12(10)	15(12.5)	120

Figures in parentheses refer to percentage

Source: Survey, 2013

4.1.6 Extension service

Farmers were supported by Agritex, NGOs, farmers' unions and private companies through extension and training to improve productivity. All the smallholder farmers who either supplied the informal or formal markets had access to agricultural extension services. Farmers received the extension services from more than two sources. The major source of extension support was (Government of Zimbabwe) Agritex followed by farmer associations (Table 4.5). This is consistent with study by Owens *et al.* (2003) which demonstrated that the extension services provided by Agritex had been an effective tool to boost agricultural production. Although farmers, irrespective of their pattern of sale seemed to depended on Agritex, chi-square test ($X^2 = 8.7$, $p = 0.033$) as confirmed by phi test (phi= 0.244, p= 0.033) showed the evidence of association between source of extension and market type supplied. The reason could be that those respondents who were accessing formal markets were utilising all sources unlike the other group which was mainly relying on Agritex. The major type of extension support rendered was production or crop planning information (91 per cent of the responses), followed by seed input (55 per cent of the responses) and agricultural policy information, marketing and basic financial management services (40 per cent of the responses).

Table 4.5: Source of extension service

Type of farmer	Source of Extension					
	Agritex	Private/ Buyers	Farmer Association	NGOs	Total	χ^2 -test
Informal market	68(85)	0.0	16(20)	8(10)	92	
Formal market	36(90)	4(10)	12(30)	2(5)	54	
Total	104	4	28	10	146	8.7

Source: Survey data, 2013

4.1.7 Accessibility to Credit

Table 4.6 shows that about 21.1 per cent of the respondents accessed credit. The results showed that GoZ was the main source of credit for both groups of respondents. Most of the farmers had accessed credit from the GoZ because collateral was not needed. Sixty per cent of formal market channel farmers acquired loans while 55 per cent of the informal channel farmers didn't access loan from any organisation. However, the results for respondents who supplied formal channels were not expected since only 15 per cent accessed credit from middle players such as supermarkets, processors and wholesalers. This is against the literature which shows that participation in formal markets such as supermarket channels increases credit accessibility (Rao and Brümmer (2012). This shows that supermarket did not extend credit to producers.

Table 4.6: Source of credit/finance for smallholder farmers

Market Type	Source of credit/finance					
	None	GoZ	Banks	Private Company	Farmer Association	Total
Informal	55(68.8)	15(18.7)	-	-	10(12.5)	80(100)
Formal	16(40)	11(27.5)	2(5)	6(15)	5(12.5)	40(100)
Total	71(59.1)	26(21.7)	2(1.7)	6(5)	15(12.5)	120

Source: Survey, 2013

4.1.8 Land holding patterns and ownership rights

Table 4.7 shows distribution of smallholder farmers according to the type of land model. The majority of respondents who supplied informal markets had land under communal model whilst the majority of respondents who supplied formal markets were under old resettlement model. Chi-square test (X^2 =33.5, p= 0.001) for independence between market channel and farm model showed evidence of association. Phi test (Phi = 0.528, p = 0.001) confirmed the results. This meant that there was significant difference between respondents who accessed informal channel or formal channel in terms of land models. This confirms the literature which says that formal markets are near absent in communal areas (Reardon and Berdegue, 2002). The formal market may not be accessed by communal farmers as supermarkets[2] prefer to source from organised farmers. This compels many communal smallholder farmers to participate in the informal market without any alternative output market.

The survey results showed that smallholder farmers were operating under different tenures. All land held under communal model fell under customary tenure, this meant that majority of informal market participants (70%) were operating under customary tenure followed by 20 per cent which was operating under permit tenure and lastly 10 per cent under leasehold tenure. No participants from informal market were governed by freehold tenure system. Unlike informal market participants, majority from formal markets had permit tenure (40%) followed by leasehold tenure (35%), where as only 15 per cent and 10 per cent were operating under customary tenure and freehold tenure.

Table 4.7: Distribution of farmers by land models

	Farm model				
Market type	Communal model	Old model	A1 model	Total	X^2 -test
Informal	56(70)	16 (20)	8(10)	80	
Formal	6(15)	18(45)	16(40)	40	
Total	62(51.7)	34(28.3)	24(20)	120	33.5

Figures in parenthesis represent percentage

Source, survey, 2013

[2] Supermarkets are the major middle players in the modern agri-markets linking communal farmers to different consumers (Reardon and Berdegue, 2002).

Table 4.8 shows descriptive statistics of land size. About 74 per cent of the formal channel farmers had land holdings between 4 and 6 hectares. Approximately 76 per cent of the informal channel farmers had land holdings falling between 3 and 4 hectares. The average land holding size for the formal market farmers was about 4.75 hectares whilst for the informal-channel farmers was about 3.57. The Z-tests (6.07) was greater than 1.96, which showed that the two means were significantly different. Among formal market participants, an average of 1.5acres were under irrigation for horticultural production which were situated almost 1km from the homesteads of households while average of 1.3 acres for informal market participants. The farmers who supplied formal markets had slightly bigger pieces of land than informal channel farmers.

Table 4.8: Average land size

Market type	N	Minimum	Maximum	Mean
Informal market	80	2	8	3.57
Formal market	40	4	6	4.75

Source: Study survey, 2013

4.1.9 Major household asset

All households from both formal and informal markets owned hand hoes, ox-plough and knapsack as some of essential farm tools. The proportion of farmers owning cattle was insignificantly different. Respondents from both groups perceived cattle as one of the most important assets in tomato production and marketing. The cattle were used for land preparation (cultivation) and transportation of produce to the nearest market place such as Domboshava Showground or to the main road connecting to urban market (municipal Musika). Lorry/pickups as most versatile and useful long-term investment that can be made on the farm was owned by very few farmers from both sides. Approximately 15 and 4 per cent of farmers from formal and informal market had access to important tomato production infrastructure such as greenhouses respectively. The difference in proportions of farmers owning agricultural assets is statistically significant for greenhouse and carts. All farmers used irrigation technologies ranging from watering cans to the state of art pipe systems. The majority (95%) of the respondents drew their water for domestic use from boreholes whilst nearby rivers and deep wells were the major sources of water for irrigation purposes. A Chi-

square test (7.36) of independence revealed enough statistical evidence of association between asset ownership and market type supplied at 5 per cent level of significance. In light of this statistical evidence, it can be conclude that the type of market supplied by smallholder farmers influences investment in agricultural equipment.

4.2 Socio-economic factors influencing market choice

The preliminary analysis aims at characterising the typology of farmers and assessing if there are any significant differences in socio-economic characteristics possessed by farmers. This section presents quantitatively how the socio-economic characteristics influence market choice. The logit model results are presented in table 4.9. In this study, the model chi-square was 75.515, which was statistically significant at $p < 0.005$. Since it had a low significance value the study concludes that this was a useful model. Exp (ß) is the odds ratio that describes the impact of a one unit increase in the independent variable on market access, adjusting for the other independent variables. In other words, it represents the extent to which raising the corresponding measure by one unit influences the odds ratio.

The number of production cycles per year was statistically significant at 1 per cent level. The Exp (ß) for production cycle was 40.225; therefore, the odds of participating in formal markets were 40.225 times greater for smallholder farmers who had two production cycles than smallholder farmers who had one production cycle per year. The odds ratio of participation in formal market for the smallholder farmer with 1 more additional cycle per year is 40.225, so the resultant is reducing odds of not participating in formal market by 97.55 per cent. The possible reason could be that the smallholder farmers would be able to constantly supply tomatoes throughout the year.

Quantity supplied was also statistically significant at 1 per cent level. This is sufficient evidence to support that the quantity supplied was likely to influence smallholder farmers to supply the formal channels. The odds ratio value was 29.874, meaning that the odds of participation in formal markets for the smallholder farmers who were producing 200 kg per week were 29.874 times larger than the odds for the smallholder farmers who were supplying less than 200kg per week. An increase of one unit (200kg) is associated with 288 per cent increase in odds of participating in formal market. The reason could be that most farmers avoid growing the in summer season due to lack of facilities like green houses. This causes

them not to constantly supply tomatoes resulting in their expulsion. This is supported by World Bank (2008) which showed that smallholder farmers face barriers to accessing emerging restructuring markets because of low and inconsistent in quantity supplied.

Distance from the city centre where formal markets were situated was statistically significant at the 5 per cent level. Since odds ratio (0.244) is less than one, thus increase of one unit in distance was associated with 76 per cent decrease in odds of participation in formal markets. There has been a noticeable deterioration in roads systems in the country. Options for transport in remote communal areas are declining because of increasing fuel costs and reduced availability of spares resulting in reduced number of transport operators fuelled by poor feeder roads. The implication is high transaction costs for both the farmers and supermarkets/processors/wholesales. They have to travel long distance to market the produce as farmers or collect produce as supermarkets/wholesalers. The supermarkets, wholesalers and processors would choose to exclude farmers who are distant from city centres. Farmers without transport have limited options for marketing their produce and often participate in low value market chains.

Quality, education, training, gender and land size were not statistically significant at 10 per cent level. It showed that there was insufficient evidence to support that these independent variables influence the participation of the smallholder farmers in formal markets. This is inconsistent with some researches which indicate that smallholder farmers are excluded from supermarket channels because of poor quality products (FAO, 2012,). This can be attributed to the intensive agricultural training program that was introduced by the government in 2005 and availability of inputs that improved after formation of inclusive government. Regarding to agricultural training, education and skills development, the government of Zimbabwe increased the number of agricultural colleges and vocational training centres located in all the provinces of Zimbabwe, six of which offer diplomas in agriculture namely Chibhero, Gwebi, Mazowe, Rio Tinto, Mlezu and Esigodini while the rest offer certificates. As a result government increased the number of extension officers in all provinces, providing technical expertise and support, reducing extension officer to farmer ratio. About 80 per cent of smallholder farmers who participated as respondents in the survey commended the government on extension services indicating that, despite the fact that extension officers were operating in an environment of limited resources, the department was striving to meet its

goals in the delivery of services. This had enhanced the creation of information and dissemination on technical knowhow resulting in high quality. However, other respondents (20 %) showed that the extension officers in the field lacked information about markets and modern technological systems, yet these have become pre-requisites for successful modern agriculture. Reasons cited were that most government extension officers had no access to communication technologies such as computers and were, therefore, lagging behind. Land size was also not significant indicating that land reform program was successful in decongesting farmers in rural areas as one farmer could own 5 hectares.

Table 4.9: Socio-economic factors influencing market choice

Supermarket channel	B	S.E	Sig.	Exp (B)
Gender	0.895	0.816	0.273	2.447
Age	-1.265	0.945	0.183	0.285
Education	1.023	0.802	0.201	2.768
Training	1.567	0.723	0.056	4.745
Experience	1.675**	0.750	0.026	5.344
Cooperative member	1.415**	0.715	0.050	4.116
Land ownership	-0.193	0.747	0.797	0.824
Market information	0.130	0.806	0.872	1.138
Production cycle	3.698***	1.050	0.000	40.366
Land size	-0.828	0.727	0.254	0.436
Extension	1.111	0.965	0.250	3.037
Distance	-1.410**	1.133	0.038	0.244
Credit	2.511**	1.007	0.013	12.317
Quality	1.458	1.020	0.154	4.228
Quantity supplied	3.397***	1.214	0.005	29.874
Greenhouse	2.917***	0.954	0.002	18.485

Source: Survey
** 5% significance level and *** 1% significance level.

4.3 Identification of supply chains within the tomato sub-sector

This section presents the supply chains which were identified during the research under supply chain and product volume mapping and supply and distribution system.

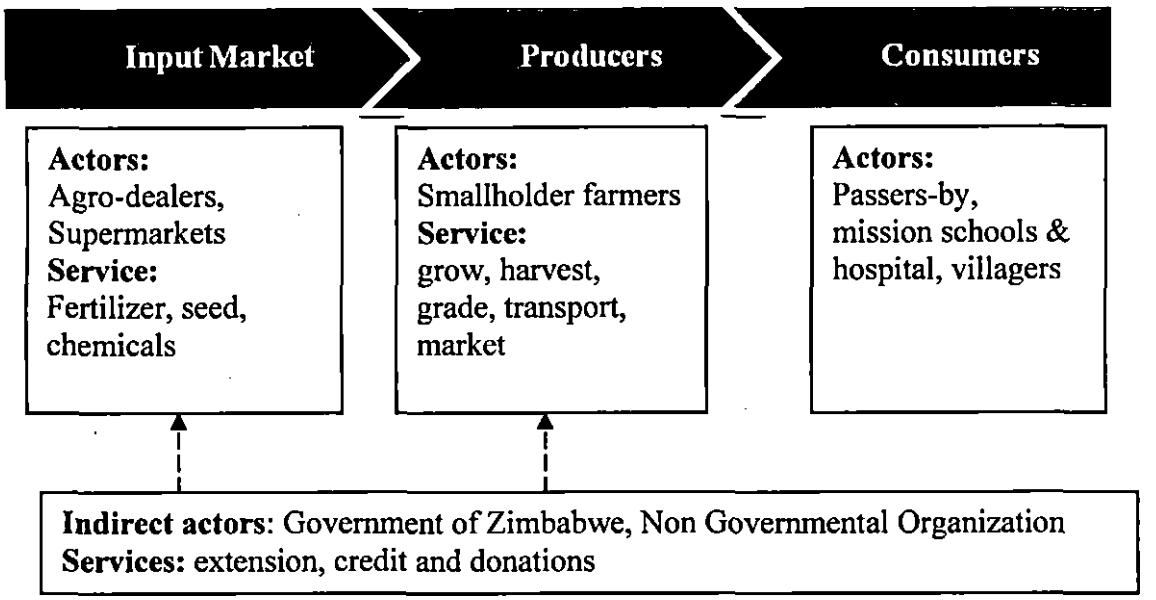
4.3.1 Mapping supply chain

There were a lot of commodity exchanges along the chains among the actors. Figure 4.3 shows the four simplified supply chains, which were common in the area of study. Supply chain 1 (fig 4.3) involved direct marketing, operating through the informal sector that included road side marketing with proportion of 12.5 per cent of respondents. Farmers were selling to mission schools, mission hospitals, villagers and passers-by. Some tomatoes were passing through municipal markets which were dominated by hawkers (chain 2). Approximately 54.2 per cent of respondents were participating in this chain. The chain was targeting low class urban residents. In the third supply chain, produce were passing through the formal supermarket targeting the medium and high class urban residents. Approximately 22.5 per cent of respondents was part of chain players. Chain 4 was the formal chain characterised by the wholesalers and processors that feed into supermarkets and other small shops. About 10.8 per cent of respondents were participating in this chain. The chain targets the medium and high class urban residents.

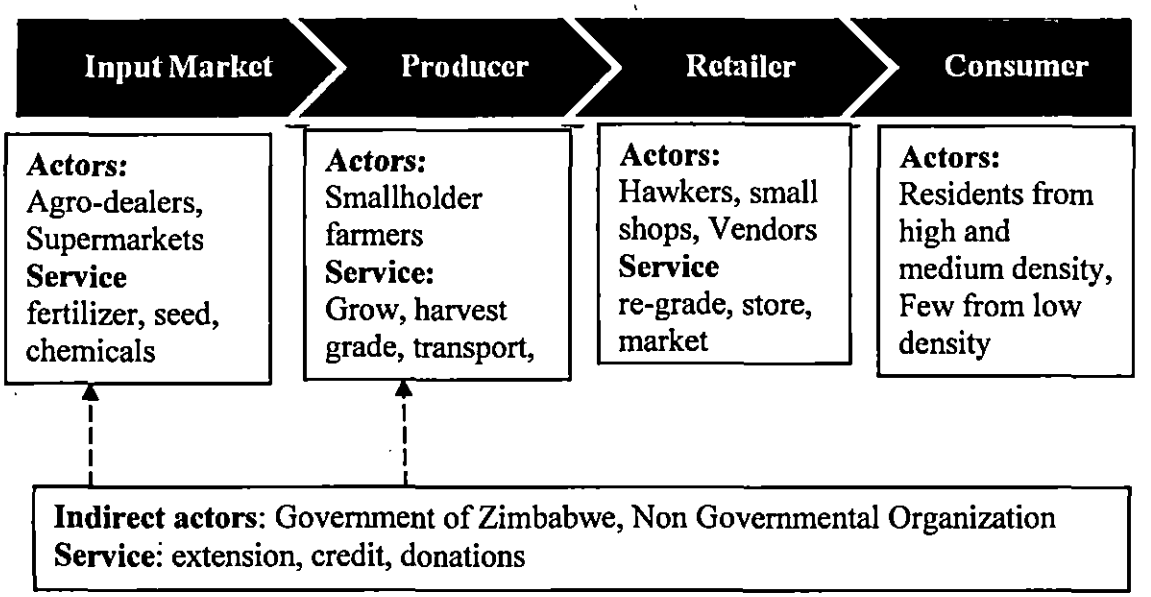
The tests for population proportion (Z=7.70) showed that there was a significant higher proportion of farmers who supply informal market than formal market. This confirms the literature which says that formal markets are near absent among smallholder farmers (Reardon and Berdegue, 2002). The formal market may not be accessed by communal farmers as supermarkets prefer to source from peri-urban farmers to reduce transaction costs. This compels many smallholder farmers (66.7%) to participate in the informal market which is the only available alternative output market. Comparing the proportion of chain 3 and 4 the research results concurred with the literature which shows that supermarkets are the major middle players in the formal linking communal farmers to different consumers (Reardon and Berdegue, 2002).

Figure 4.1: Tomato supply chains

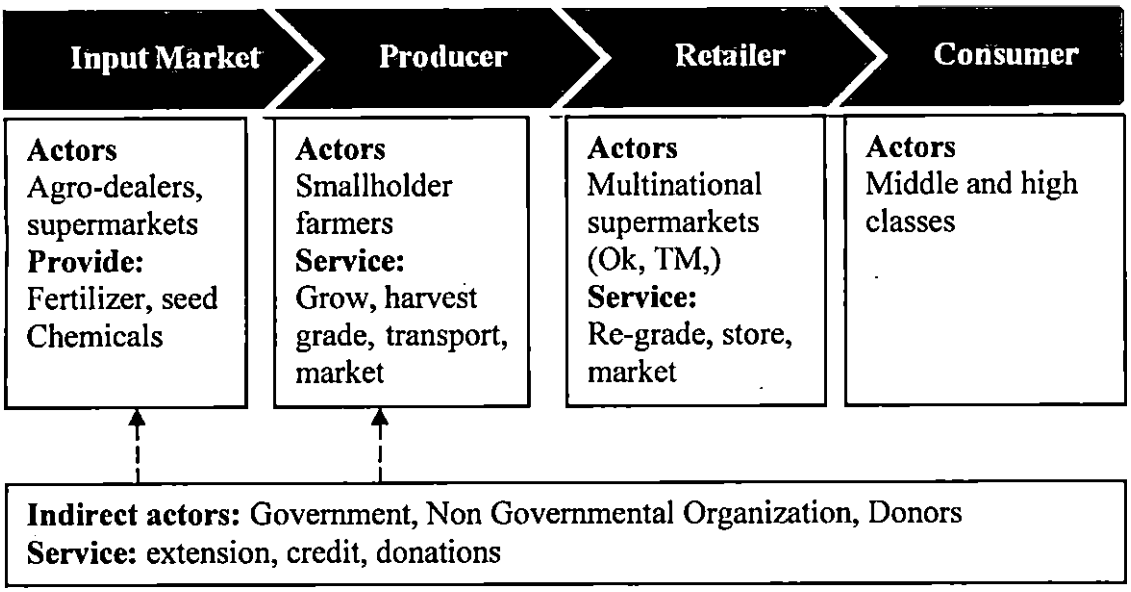
Chain 1



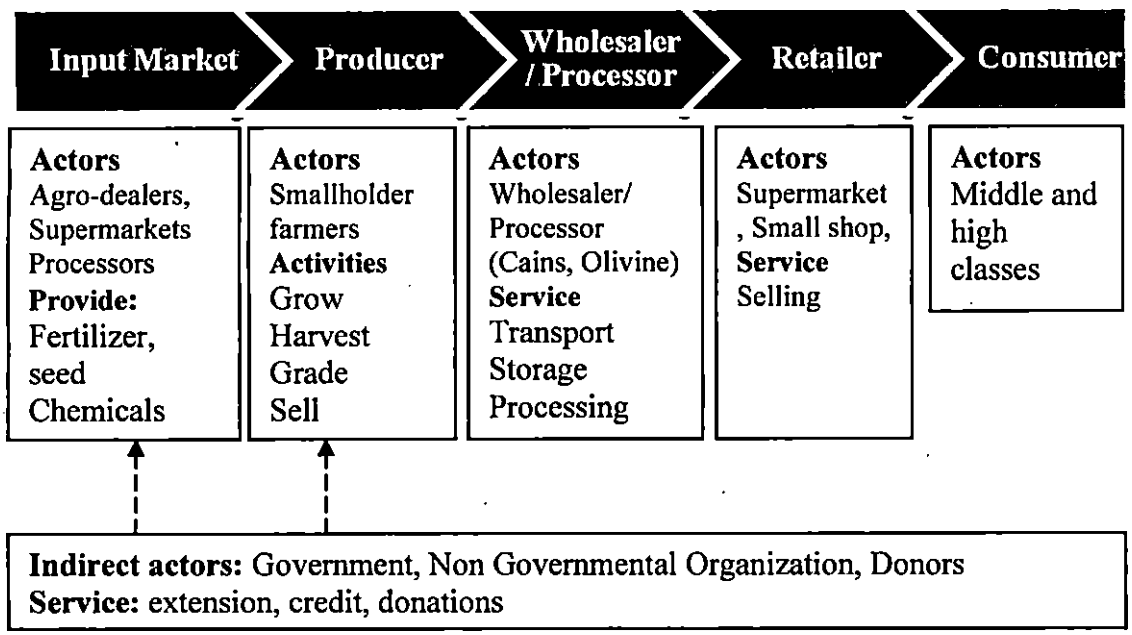
Chain 2



Chain 3



Chain 4

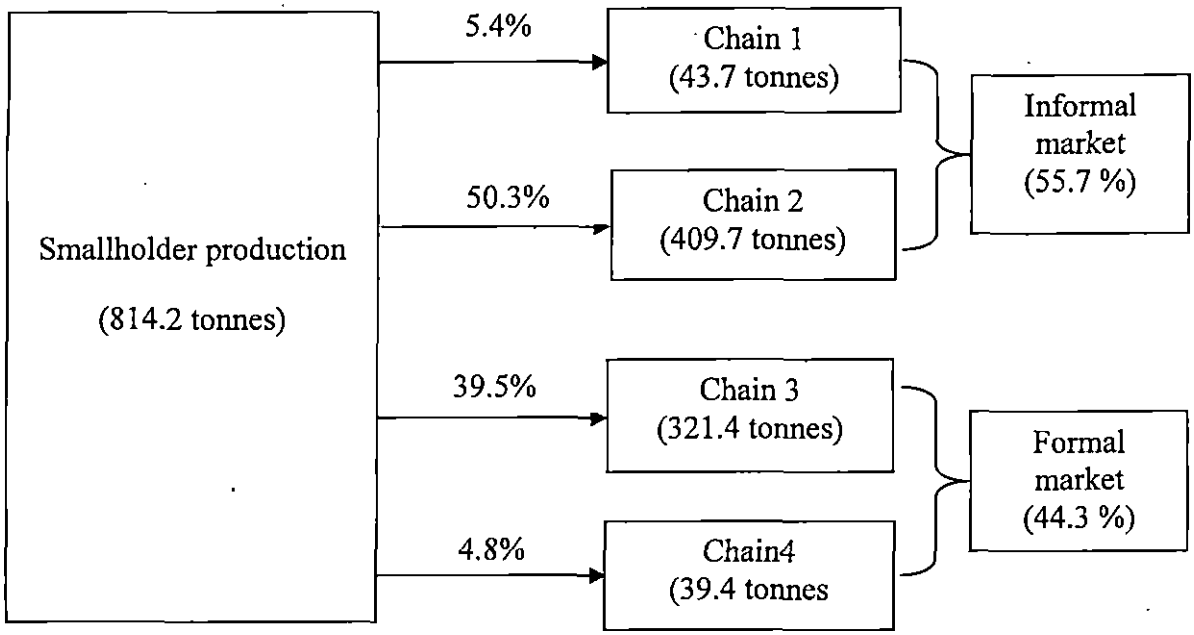


4.3.2 Product volume mapping

Product volume mapping enables to track down the product throughout the supply chain. The purpose of finding out this dimension is to have an overview of the size of the different channels within the supply chain. Volume mapping results indicated that a total of 814.2 tonnes of tomatoes were produced in Mashonaland East province under the period of study (2012/13 season) from respondents. Figure 4.3.1 shows that the chain 2, which involved

municipal markets, was the largest tomato supply chain handling about 409.4 tonnes of tomatoes in one production cycle during the period of study. Chain 3, which involved farmers to supermarkets in the formal market, was the second biggest chain handling 321.4 tons in 2013 season. This is contrary to the research conducted by Poole *et al.* (1999) which estimated that 1 per cent of tomato produce in Mashonaland East from smallholder farmers was going through formal markets, which was a very small percentage. This shows great improvements. The supply chain 1 which ended in the informal local market came third with 43.7 tons and lastly the chain 4 with 39.4 tons. Overall, informal market was larger than formal market in terms of quantity handled as the two markets handled 55.7 per cent and 44.3 per cent respectively. This shows that informal markets are still the main conduit for produce in the country. The results were similar to the ones which were found in Latin America (Reardon and Berdegué 2002). Therefore, integrating smallholders into informal markets or improving aspects of informal supply chains are likely to have strongly pro-poor outcomes because of this sector's broad base.

Figure 4.2: Product volume mapping



Source: Survey data, 2013

4.3.3 Supply and distribution system within the tomato sub-sector

The aim of this section is characterise the key functions, technologies and participants involved in the tomato supply chain in the area of study. The emphasis is on the various functions involved from the input and service supply until tomatoes or its products are made available to the consumer. Actors in the tomato chain were divided between direct and indirect participants. Characterisation was done by describing each stage of the chain.

4.3.3.1 Stage 1: Input supply

According to Jackson, *et al.* (1997), access to inputs, credit and the organisation of appropriate labour have been key determinants of tomato production in Zimbabwe. The input market was characterised by agro-dealers, supermarkets, farm supplies stores (Farm and City and National Tested Seeds, and fertiliser manufacturing companies.

a) Seed suppliers

The majority of respondents (95%) used hybrid seeds obtained from a reputable source, while only a few farmers relied (5%) on retained seed. Smallholder farmers accessed seeds that were distributed largely through retail outlets, notably chain supermarkets such as Town and Country, OK, TM and Miekles and farm supplies stores. Respondents supplied supermarkets/ wholesalers were also buying from the above mentioned sources. The respondents were using seeds obtained from reputable sources to make sure they had not expired or near expiry date. Expired seeds may not germinate or if they germinate may produce weak plants which may not produce best fruits or high yields. This could be a reflection of the positive effects of capacity building interventions within horticultural production contexts i.e. high adoption levels of new technologies (seeds) as a result of extensive promotion of hybrid seed varieties by private agro-input companies and by public support organizations such as the Department of Agricultural Research and Extension Services (Agritex). From a farmer's point of view, this could be attempts to utilise the recommended seed types and planting materials as a way of ensuring optimum yields and better returns for the farmer' investment. Existing and new seed varieties were promoted through field days, where farmers were encouraged to visit research facilities or seed multiplication sites. Seed suppliers offered training for employees in the agriculture sector on appropriate agronomic practices to ensure optimum yields. In

addition, teams of professionals visit farmers/growers to offer technical backup on occasional periods.

b) Fertiliser and chemical suppliers

The general unavailability of fertiliser experienced countrywide affected tomato production particularly small scale production. Zimbabwe has an oligopoly market for fertilizers serviced by three fertilizer-manufacturing companies. Zimbabwe Fertilizer Company Limited (ZFC) and Chemplex Corporation are Zimbabwe's largest manufacturers of fertilizers and agricultural chemicals. The companies serve the entire farming community, namely large-scale commercial, communal, resettlement and small-scale commercial sectors. ZFC sells directly to the farmer or via stockists, co-operatives, traders and its own depot network. ZFC provides fertilizer and chemical recommendations and instructions for correct and safe use of product. ZFC imports more than 150 different agricultural chemicals that include herbicides, fungicides, fumigants, insecticides and specialty chemicals. All crop chemicals are imported with the smaller volume products being ready for use while the large volume products are formulated, re-packed and labelled at ZFC's crop chemical plant in Kwekwe. ZFC has distribution agreements with several of the world's leading principal manufacturers of agricultural chemicals such as Bayer, FMC, Monsanto and Syngenta. ZFC has 13 depots established throughout the country. The company also has an extensive network of stockists and agro-dealers nationwide. Chemplex Corporation as one of the largest fertilizer and chemical manufacturing company in Zimbabwe mines phosphate rock which is used in the manufacture of fertilizers.

From 2006 to 2007 there was a 70 per cent decline in the supply of special fertilizers, most of which were used in horticulture. In 2013, the fertilizer manufacturers were operating at about 30 per cent of their capacity largely due to foreign currency shortages to import potash, which is one of the key raw materials. As a consequence, only 10 per cent of the national fertilizer requirement was produced. The government has become a major buyer for the scarce fertilizer and chemicals for its food security programs, crowding out private sector participation in the market. Due to the shortages in the formal market, fertilizers for horticulture are therefore now largely sourced from the parallel market subjecting the commodities to inflationary pricing. The use of formal agents and agro-input distributors is on the decline partly due to the challenges of a poor economic performance.

The short supply of fertiliser had been cited as the major constraint by respondents (85%) in the input market. Those farmers (10.8%) that had contracts with processors/wholesalers obtained their inputs on contract and the cost of the inputs was deducted from the purchase price of the produce. Where fertiliser had been available, notably on the parallel informal markets, these have been unaffordable as on average 50 kg bag was costing US$30 but in formal sources was US$15 per 50kg bag. The respondents revealed that due to fertiliser shortages and the unaffordable prices in the parallel market, they were now relying heavily on fertiliser distributed through various government support programmes e.g. the Grain Marketing Board (GMB)'s input scheme, and e-voucher program. The shortages of inorganic fertilizers forced farmers to place their faith in kraal manure because of its affordability. Thus, manure from kraal formed a major part of their production system. Consequently, low levels of yields are normally experienced according to respondents.

Approximately 65 per cent of respondents were buying fertiliser and chemicals from major cities such as Harare and transport them themselves to their farms. This confirms the literature which says that one of the major hurdles smallholder farmers face worldwide is that agricultural input and service companies have little incentive to send their marketing representatives to remote areas. The high cost of fuel and poor infrastructure makes it costly for input providers to reach millions of smallholders. Consequently, input suppliers fail to build demand for their innovative products, while farmers miss out on productivity-enhancing technologies that would substantially enhance their incomes.

4.3.3.2 Production stage: Production system

According to respondents (75%) basic requirements for growing tomatoes include land, water, tomato seeds or plants, fertiliser, trowel or small shovel, any thread for tying plants to supporting sticks or poles. Farmers chose land in an area that receives eight to ten hours of sunlight during the day and has good soil and good weather conditions. The majority of respondents were starting the tomato-growing project from the seed instead of buying seedlings. The most common grown varieties were rodade followed by roma, heinz and floradade. Rodade variety was common among all respondents, either supplying to informal or formal markets. Rodade has medium fruit size and firm fruit good for transport and marketing. However, respondents expressed their concern over the process of stake since the variety yields better if staked. Most farmers were sowing seeds 0.5 to 1.5cm under the

ground. The respondents indicated that they transplant other seedlings three weeks after the first crop to spread the harvest out. The fruit was picked when it has reached full-size and colour. Tomato fruit was picked earlier and stored indoors to ripen. This helped lessen their chances of rotting in the field.

In the study area, production of tomatoes was mainly carried out during the summer, although some could be grown throughout the year (including the winter season), albeit with lower yields and poorer quality. Their production calendar was determined by the geophysical conditions such as altitude, temperatures and water availability (Table 4.10). Since tomato production was under irrigation, the production was mostly concentrated on vleis and vlei-margins or, more generally, where water supply was assured, e.g. nearby dams or soak well. Approximately 52.2 per cent of the respondents who supplied informal market managed at most two production cycles per year whilst all who supplied the formal markets on average were producing three times. The respondents (85%) cited water availability and winter season (frost period) as the factors that primarily affected the number of the production cycle. Most farmers avoided growing the crop during low temperature seasons due to lack of facilities like Green Houses. Farmers held off until after the cold season. Tomato plants are sensitive to frost and other harsh weather conditions caused by the winter season, hence winter tomato produce were fetching a high price as the supply was far outstripped by demand.

However, the respondents explained that tomatoes were cheap to produce during the dry summer (early September to early November) than wet summer because pest and disease pressures were too high in the rainy season, resulting in high protection costs. In some cases, land became waterlogged resulting in low yield. The need to reduce the risk of staple crop failure also results in gardens being planted to maize at the expense of tomato in summer because gardens often have better residual moisture. The provision of enough household support therefore becomes compromised during this period.

Table 4.10: Tomato production calendar

Sowing time	First fruit ripening	Harvest
January	April/May	May/June
February	May/June	August
March/April	July-August	August/September
May	September	October
September/October	January/February	February/ March
November/December	February/March	March/April

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Source, Survey data, 2013

Key	
	High supply
	Low supply

a) Tomato production techniques during winter

Some of the respondents (48%) were producing tomatoes outside their normal production window as a way of maximising production and returns. They were producing the crop when there are forecast of shortages in the market and subsequently higher producer prices. Since access to infrastructure such as greenhouses ensures that tomatoes can be produced throughout the year was a big problem, farmers were improvising. The respondents indicated that they used cooking oil or milk bottles filled with water to keep tomato plants warm. They filled cooking oil or milk bottles with water until they were three quarters full. While the plants were still young, they placed the bottles upright on the ground among the tomatoes. They placed one bottle beside every third plant in every other row. They would make sure that the neck of the bottle appears above the plants. When the plants got taller than the bottles, the farmer placed stakes beside the tomato plants. They hanged bottle on each stake with a string. The bottles were hanged 10 centimetres above the plants. Some respondents showed that they used plastic devices. They used clear plastic devices that had long tubes connected in a circle. Once the tubes were filled with water, they would stand up on their

own and provide a great deal of frost protection for early tomatoes. The water filled tubes heat up during the day and retained heat during cold nights to protect plants. These thick water walls provided effective insulation to counter cool temperatures. The water walls needed to be staked to prevent them from blowing over with strong winds. After frost dates had passed, these devices could be removed. If they could get light frost overnight without covering up their plants, they went out early before the sun rises, and spray plants with the garden hose. This melts the ice off the plants and may save them. If a more serious frost is coming, the respondents showed that they could cover their plants with something to keep the frost from ending up on the leaves. Farmers use materials like plastic, sheeting, newspaper or other material that can be used like a gentle covering will suffice. They leave the cover on until the temperature breaks that frost level in the mid morning and their plants will be none the worse for wear. They make sure that the material used to cover plants is lifted slightly off the plants so they have a little breathing room and do not, however, leave plastic on the plants in the hot sun as this can damage the tomato plant. However, farmers disagreed on the material that can produce desired results. Some believed cloth was the best as plastics did not sufficiently shield plants from frost whilst others felt that plastic was the best material to use.

b) Production labour requirement

The agricultural industry covering both the smallholder and commercial farmers is experiencing labour shortages. In those households interviewed, most farmers worked with their families and spent about 16 hours per week in the tomato production. Hired labour and working groups spent about eight hours per week or less. There was labour sharing in the family with the men concentrating mainly on land preparation while women and children did the planting, crop husbandry and marketing. Shortage and high cost of labour is one of the production constraints given by the respondents. For households with inadequate labour resources, this input becomes another very expensive and scarce. This is because, in addition to labour resources absorbed by formal employment, gold panning and illegal diamond mining activities and youth crossing the border in search of employment in neighbouring countries particularly South Africa have worsened the situation. This is contrary to popular beliefs that smallholder farmers are more competitive on more labour intensive production systems because they have more underutilised labour. Table 4.11 shows recommended amount of labour by Government of Zimbabwe (2012) for farmers to realise maximum

possible tonnes per hectare. Comparing average family size of 5 members or 6 members[3] with the total amount of labour (391.6) required this shows that although family labour was the main component of labour supply for respondents, hired labour and work groups were vital during periods of critical labour shortages. Much of the additional labour was hired during staking, planting, and harvesting as opposed to weeding and spraying. On average each household hired labour which was less than 30 labour days per season including those supplied supermarkets and wholesale or processors. Competition for labour was high in summer when field crops were at peak demand for labour resulting in tomato production being sacrificed. The majority of respondents (85%) were relying mainly on farmer working groups. Working Groups were created to address a specific labour problem during shortage periods. Working Groups are informal and generally short-lived. Upon completion of its goals and achievement of its objectives, the working group is dissolved. Working groups are formed by interested famers from the same locality. Working Groups have a chairperson who facilitates the group discussions and offers leadership and guidance to the working group. The leadership engages meeting in order to gauge the level of support for the proposed working group. The chairperson also serves as the contact person for technical questions about the schedule. In addition, to avoid postharvest loss due to lack of labour respondents indicated that they staggered the planting of the crop such that it did not mature all at once as much labour was demanded at harvesting and marketing time. That way, farmers would have an early, mid and late harvest rather than having their tomatoes come in all at once. The respondents labelled tomatoes as labour demanding vegetables.

[3] On average a family has 2 economic inactive members (survey results).

Table 4.11: Labour requirement for irrigated tomato per 1 ha (man days)

Task	Month						
	1	2	3	4	5	6	Total
Manuring		0.6					0.6
Seedbed	2.0						2.0
Land preparation		2.0					2.0
Basal application		3.3					3.3
Planting by hand		20.3					20.3
Staking		120.0					120.0
Disease & Pest control	10.0	10.0	10.0	10.0	10.0	10.0	60.0
Top dressing		1.0	1.0	1.0			3.0
Pruning & Trellising			10.0	10.0	10.0	10.0	4.0
Weeding		2.0	2.0	2.0	2.0	2.0	10.0
Irrigation		1.5	1.5	1.5	1.5	1.5	7.5
Harvesting						57.6	57.6
Marketing						30.0	30.0
Contingency (10%)	1.2	16	2.5	2.5	2.4	11.1	35.6
Total	13.2	176.4	27.0	27.0	25.9	122.2	391.6

Source: Government of Zimbabwe

4.3.3.3 Marketing stage: Tomato marketing by smallholder farmers

Unlike most agricultural products which are controlled, tomatoes are uncontrolled commodities. The market for small scale tomato farmers is characterised by a dual system, the informal and formal market. Tomatoes are sold in a wide variety of places and ways which include street vendor, hawkers, roadside, specialist groceries, supermarkets, processing companies and municipal urban markets. Although most organizations were vocal about promoting production for marketing, they were silent about facilitating the actual process of marketing. Those who preferred silence admitted that marketing was a difficult subject because of the conditions in which the farmers lived. They indicated that some small scale producers have been producing high quality products compared to large scale producers, but the small scale farmers have not been obtained real value to their produce.

Road side marketing

The growth of business is unlikely to succeed as the customer base in the local market is low fixed, unless other sources of cash income are present in a village, a very limited amount of money gained from selling agricultural products to neighbouring households circulates. Respondents showed that sometimes they ended up having nowhere to sell crops and the produce went, literally, back to the dust where they came from after destruction by the elements as local market did not always clear the supply since population of buyers was erratic.

b) Informal urban tomato markets

In Zimbabwe as in other sub-Saharan African countries, the town market is the scene and hub of direct transactions among producers, retailers and consumers. The respondents (54.2%) were accessing Harare urban municipality markets. The proportion of Harare urban population was estimated to constitute over 25 per cent of the total population, giving a total Harare urban population of over 2.5 million people and on average a family of four consume 10 kg of tomatoes per week (Central Statistical Office, 2012). It can therefore be seen that the informal urban market is quite large.

Urban markets were dominated by municipal markets such as Mbare musika, Chitungwiza and Lusaka (Machipisa) which were on average 100 km away from the farms. Mbare Musika was the biggest market which handled approximately 200 000 tonnes of vegetable produce per year from smallholder farmers. Jaure (1997) indicated that the customer composition for municipal market is as follows: 52 per cent hawkers operating from city council market stalls, 28 per cent hawkers operating form street corners, 9 per cent middlemen, popularly known as makoronyera (fly-by-night traders) who operate as small-scale wholesalers and 11 per cent other customers including the public.

The municipal markets are 1.8 meter walled and sub divided into stalls each measuring $2*2m^2$. A daily charge is levied at US $10 per stall by municipality. On average, famers pay for two installs to accommodate their produce. The market opens at 4:30 a.m. in the morning and closes at 10:30 a.m. This has been done in order to facilitate the cleaning of the market area in readiness for the following day. The farmers with the remaining produce are inconvenienced since they are required to carry their produce outside the market place but no temporary area is provided for this purpose. On bringing their produce back into the market

the producers are required to pay again. Most of the produce was delivered by small trucks. Farmers search for transport whilst they have their produce on the road. Transport costs include the costs of accompanying the produce to the market. The transporter charges fixed fee per box (US$0.1 per kg) and he is reimbursed as soon as the produce is sold. Farmers hire labour to off load and take produce into the market place. Farmers use their hands to grade their produce basing on size, shape and general appearance such as whitish sports. They use wooden or sandark crates as tomato package materials. If however, the farmer purchases fertilizers or other inputs, he is charged a transport fee to transport his inputs. In addition to transport cost, the farmer incurs accommodation and food costs while waiting for the market to open. Sometimes farmers are sleeping in the open during winter as city council is failing to provide decent shelter. Farmers are asked to pay US$10 per day but council fails to provide shelter. However, some farmers arrive as early as 3:00 a.m. with loads of tomatoes among other garden products. They travel through the night to arrive at the market in the early hours of the morning as they do not have refrigerated trucks. Interviewed farmers indicated that delivering produce to urban municipal market is fraught with problems. The buyers at municipal market crowded the farmers and a lot of produce is stolen in the process. In fact it is suspected that some buyers (fly by night traders, makoronyera in local language) organise themselves in order to steal from the farmers.

The respondents expressed their displeasure over fly-by-night middlemen. They sell their products in bulk to middlemen, known as fly-by-night middlemen, who pack the products in smaller portions, crates or pockets. Farmers indicated that it paid more to sell straight to vendors and retailers. If famers sell to fly-by-night middlemen, fly-by-night middlemen get much more than what farmers get as farmers blindly accept the prices offered. Respondents revealed that municipal police were accepting bribes from fly-by-night middlemen, prejudicing smallholder farmers making difficult to address the issue of fly-by-night middlemen. Respondents further more showed that city councils lacked a detailed plan on how they intended to de-congest the municipal agricultural produce markets. The market is congested especially Mbare Musika. The market place is full of full of pressure as trucks are unloaded at speed, urgent deals are made with farmers, transporters and sales representatives, all amid carts piled high with potatoes, green peppers, tomatoes, leafy greens, bananas, apples, cabbages and so much more. Farmers have to spend much time at least two days in municipal markets because of pressure.

At the municipal markets such as Mbare, each producer bore responsibility for transporting produce, finding customers and seeking market information to guide in bargaining for a fair price. This means that every farmer was responsible for selling his own produce. Farmers tout prices, inviting customers to buy from their stalls. Prices at municipal markets fluctuate wildly from day to day, and even within a given day and also intra-seasonally. Although demand and supply play a greater part in determining prices final price was established through negations. Prices were sometimes quite good to the extent of being higher than those offered through contracts. However, in some instances the market was flooded such that the price at which the produce was bought might be so low that the farmers were not able to recoup the cost of transport they would have incurred, let alone recovering production costs. However, this depends on the nature of the season.

Access to market price information was not uniform as information flow was sporadic. Respondents (66.7%) were lacking up to date market price and quantity information. Agritex tries to collect current market information, but distribution in time is a big constraint. The source of information on prices other than by word of the mouth is the Herald Newspaper with both radio and television rarely broadcast the program for farmers. Furthermore, the flow of information is sporadic. Hence, farmers often start production without market information.

c) Supermarkets

Three of the country's major supermarket chains OK Zimbabwe, TM Supermarkets and Spar were characterising one of the two formal tomato supply chains with new entrants such as Food World, Food Chain, Town & Country and Afro Foods.

About 90 per cent of interviewed supermarkets revealed that supermarkets have never been so dominant in the Zimbabwean food chain. There are a number of reasons for this lag:

- The upper and middle classes are still the main customers for fresh tomatoes from supermarkets which constitute minority in the country.
- There is a tradition of daily fresh vegetables purchase for freshness
- Small shops and street fairs fit easily into dense urban areas where supermarkets cannot physically locate and so shoppers can reach them on foot every day

- There is evidence that street fairs and small shops are able to charge prices below those of the supermarkets, especially where they are family businesses paying less
- High value attached by middle and higher income groups to the purchase of fresh produce in local street markets and unwillingness to pay for premier.

Interviewed supermarkets explained that farmers' markets seem to be popping up all over the place these days, which is excellent news for local consumers. There is a significant difference between supermarkets and farmers' market produce. Supermarket produce is normally shipped into an area by truck in bulk which is stored for several days in the grocer's cooler. By the time the consumer buys it, it has lost most of its flavour and nutrition. Produce found in municipal market is usually harvested daily which means that it not only contains more nutrition but much better taste due to its freshness. With so many people going green today, municipal markets are becoming more popular since the produce in the market is fresh. Supermarkets don't bargain their prices are nonnegotiable. Municipal markets deal in fast turnovers and prices are often flexible especially when approached by those ready to purchase several items. Their produce far exceeds anything found in the produce section at the supermarkets in quality and price and can actually be cheaper than growing it yourself. Thus, shopping at a farmers market puts money back into the community. The results are consistent with the findings made by Weatherspoon and Reardon (2003). Weatherspoon and Reardon (2003) indicated that the take-over of food retailing in Zimbabwe and Zambia has occurred much more rapidly in processed, dry and packaged foods such as noodles, milk products and grains, for which supermarkets have an advantage over pop stores due to economies of scale. The supermarkets' progress in gaining control of fresh food markets has been slower because of local habits and responses by wet markets and local shops (Weatherspoon and Reardon, 2003).

d) Wholesalers and processors

Agro-processing industries, especially food manufacturing, dominate the commercial industrial sector of Zimbabwe. These are mainly owned by government and multinational conglomerate companies and concentrated in big towns. Major wholesalers/processors which were found in the study are Cains and Olivine. Other players were such as Favco, Interfresh, Selby, Nutriveg and Hortico. Most of the processors produce tomato sauce. Wholesalers admitted that a high proportion of the produce they trade is from large commercial producers

in South Africa, benefiting from preferential trade arrangements and a stable supply. This remains a serious constraint to the development of Zimbabwe's tomato sector in general and placing a further strain on government services.

a) Cairns Foods

One of the largest processor is Cairns Foods, with offices and a food plant in Harare. Cairns is 51 per cent owned by Astra Holdings, which is itself 80 per cent owned by government. Cairns revealed its range of tomato products, including: tomato catsup, tomato sauce and spaghetti in tomato sauce (Tomango). Very little of its product is exported at present, although the company has plans to enter the South African and Zambian markets.

Cairns sources most of its raw materials from large-scale farmers, but management reports that last year they procured about US$ 1 000 million worth of tomatoes from small farmers in communal areas. They have produce procurement team that makes the necessary contacts with producers. Cairns supplies producers with its own proprietary tomato seed variety. The company would not supply small farmers with their proprietary seed without payment of a royalty to compensate them for possible diversion of their seed to others not selling to them. Small producers' average level of production is only about 16 tons/hectare of tomatoes, while large farms are getting between 90 and 110 tons/hectare was given as reason for preferring large producers to small producers.

Management reports that the company cannot get the volume of tomatoes it needs and would support measures to increase output from small farms. They contract with large growers for their raw material at specified prices for each season, and could do the same for small farmers if sufficient product can be bulked up at pickup locations. Pulping of tomatoes and fruit takes place during the season and is stored in drums for later processing. Constraints to increased small farmer production mentioned by management include credit for production expenses, and extension services which tell the farmer what to do when.

b) Olivine Industry

Olivine Industries have subsidiaries all over the country, is owned by Heinz (59%) and 49 per cent by the Zimbabwe government. It produces tomato ketchup under the well-known Heinz label. The company began operations in Zimbabwe in 1991, producing tomato paste. They are now in their second season of tomato paste production, produced in older-model batch-type evaporators brought from Heinz's plant in Spain. In fact, much of the equipment consists of redundant items from Heinz's various plants in Europe. The plant is operating on a one-shift basis, since they cannot procure enough raw materials from the commercial farms who are their main suppliers.

Heinz does as a rule procures most of its produce from large commercial producers at the expense of smallholder farmers. Asked why they did they do so, the representative said that small farmers generally lacked adequate supplies of water, which is absolutely essential if they are to meet delivery schedules laid down by Heinz. Another reason was that, in common with all food processing plants, they must pay a much lower price for the same product than would the fresh market, if they are to be competitive and farmers find these prices too low.

4.3.3.4 Post Harvest Activities conducted by farmer

The goal of a producer is to supply safe, high-quality produce, which confirms to consumer and market requirements. Post- harvest handling of crops has a large bearing on the market price. Handling and tossing of the produce causes bruising and poor product quality.

a) Storage of tomatoes

The storage of tomatoes plays a significant role given the perishable nature of such produce. Temperature and relative humidity management is the most effective tool for extending the shelf life of fresh horticultural commodities. The respondents were employing room cooling strategy to manage temperature. Relative humidity can influence water loss, decay development, incidence of some physiological disorders and uniformity of fruit ripening. The majority of respondents were controlling relative humidity by wetting floors in storage rooms. The study revealed that almost all informal market participants (93.3%) relied on traditional storage systems. It was found that respondents in Mashonaland East Province use mainly traditional facilities for storing produce such as their spare rooms, open air shed and

shed. The respondents were spreading tomatoes in these rooms showing that they were relying on room temperatures.

The method was perceived as ineffective since the room temperature is not artificially controlled. In most cases (66.5%), due to lack of advanced storage facilities and perishability of tomato crops, farmers found themselves accepting prices that could have been refused had the storage facilities.

b) Processing by smallholder farmers

It was noted that post-harvest processing as value addition activity was lagging behind among producers. Traditional processing techniques were found to be much more predominant among respondents than advanced processing activities. Many respondents cited inferior processing and lack of knowledge of advanced processing techniques, as reasons as to why they do not process fresh tomatoes. The respondents (100%) were familiar with sun-dried (sliced and spread to dry) or pulped tomatoes processing methods. Sun-drying of tomatoes was usually carried out in August, September and October, as rainfall is expected from November to March. The drying process represents one of the oldest food techniques used to process tomatoes. The traditional technologies used to dry foodstuffs are based on climate: sun, shade, low humidity, airflow and sometimes fire (United Nations Development Fund for Women (UNIFEM), 1993). Drying is possibly the most known way of processing tomatoes among smallholder farmers, as it is a low-cost practice. When carried out correctly, the product can maintain nutritional quality. However, when it is carried out incorrectly, it can cause losses in the nutritional content and quality of the produce and in more serious cases may lead to a risk of microbial spoilage even food poisoning. Flavour and texture of rehydrated tomatoes are felt to be far much less than fresh tomatoes making them out competed on the fresh market. Farmers would benefit if they could process and add value to their produce thus enabling them to reach far off markets without perishability constraints. Such programs would benefit farmers who have transport problems or are too far from the markets. In the case of pulping, tomatoes are selected according to ripeness, and then washed. They are then pulped in an electrically driven mechanical pulper, which separates the pulp from seeds and skins. The juice is then heated in a stainless steel pan at up to 90^0C over an open gas fired stove. The juice is checked for acidity, which should be below pH4.5. The juice can then be graded to meet various standards before being treated with preservatives,

e.g. sodium metabisulphite. The extract is then packed in tins or drums and stored at a temperature between 25-30^{0}C, ready for consumption.

c) Transportation of tomatoes by smallholder farmers

In most cases, especially in summer farmers personally take the produce to the market to ensure its safety in transit and marketing. Many farmers face the problem of high transaction costs, due to erratic and expensive transportation. Often produce is left to waste in fields for lack of an efficient and speedy transport network. Various forms of transport were used to transport produce depending on quantity of the crop and distance to the market. The respondents revealed that carts and wheelbarrows were relatively cheap and reliable means of transportation, especially when the quantities of produce were small and only transported over short distances to local markets. In the case of transport to urban markets, produce was often brought to the main road from the fields by carts and wheelbarrows and truck or lorry to the urban market destination from road side. Trucks and lorries are a common mode of transportation used by farmers to urban markets. Public transport such as buses was also used to transport tomatoes when there was transport crisis. Often farmers face great problems in finding alternative transportation at a short notice. Thus fail to shorten the time from harvest to consumption that can minimise loss of the characteristic aroma and development of off-flavours. Furthermore buses are at times selective in their route, as some areas become inaccessible during the rainy season. This is particularly the case in the areas where low bridges get swept during heavy rains. Furthermore farmers are often restricted on the quantities of produce they may carry on board by bus operators. In winter, buyers may travel to smallholder farms to buy produce at the farm gate, which is then sold to urban markets. Some individuals provide transport service to farmers for an agreed fee. All famers supplying processors indicated that they were offered transport service by contractors at an agreed rate or fee. Supermarkets were not providing transport to the farmers.

Some respondents (45%) benefited from the Agricultural Rural Development Agency (ARDA) scheme, which sought to provide farmers with a transportation service and also marketing information. Since 1987 ARDA has been running European-funded smallholder transportation project that is aimed at assisting farmers by enhancing the efficiency of transport networks. Farmers register onto the scheme through ARDA offices, after which they can have their crops (mainly tomatoes and rape) ferried by ARDA trucks to the urban

Form of transport used by smallholder farmers

market. ARDA records the amount of each individual's produce and markets it. Basically, the system is of assembly markets. The ARDA trucking scheme usually only carries goods leaving producers to take buses to the market destination and wait upon the arrival of their produce. Once at municipal market, farmers usually market their own crops. Farmers were charged $1.50 per 10 kg crate of produce for transportation. In order to ensure the equitable use of the transportation facility, ARDA allocates each farmer a specific day when they can market their crops. This disadvantages some farmers as they may be forced to sell their produce on days that are not good for business causing animosity among producers. Furthermore routes covered by single trucks are often long resulting that trucks are full to capacity before they have completed their entire route. Damage to produce on route is common as trucks are packed to capacity. In Mutoko for example, one such route is 84 km by gravel and a further 154 km by tarred road to Harare. The ARDA scheme has been crucial to farmers however, in terms of getting access to markets at the right time.

Transporters have also found big business from farmers as they transport their produce to cities on returning they go back with household goods, pumps, roofing sheets among other goods. Farmers and transporters have urged Members of the National Assembly to ensure that they engage the Ministry of Transport and Infrastructural Development to repair major roads so that they are not cut off and end up losing out because they are in areas that are difficult to access.

When there is a shortage of produce the marketing spot tends to move to the farm. When there is a glut of tomatoes on the market buyers cut down on transport costs by staying at their market stalls and the growers have to take the produce to the retailer, wholesaler or processor. In winter due to the shortage of produce in the formal markets traditionally supplied by the large scale commercial farmers, the hotels and wholesalers go out and buy direct from the smallholder farmers and not wait for the farmers to come to town with the produce.

d) Grading and packaging

The grading of produce is important as it can add value and bring higher market returns to the producer. Although municipal markets represent a largely informal market, respondents pointed out that product quality had assumed a significant importance there. This is due to the

Packaging

Wooden and Sandark crates

fact that some large-scale farmers dump produce, which was initially intended for the international market (but which failed to meet the quality standards laid down), on the municipal markets. Although this produce may be of inferior quality for the international market it may be of higher quality than that which is marketed locally. While this may boost competition among farmers to produce higher quality products for the domestic market, less dynamic farmers may fail to meet the informal standards laid down and hence may not find an easy outlet for their poorer quality produce. However, standard grades on the domestic market may help to promote uniform prices for products of similar quality. The indices which farmers were using to grade produce followed a combination of criteria relating to the maturity, size, colour, freshness and stage of ripeness. Respondents were grading tomatoes according into three grades namely grade A, grade B and C but formal markets had no grade C.

Packaging can be defined as a means of providing protection to a product, in order to ensure its safe delivery to the point of sale. The main functions of packaging are protection of the content from physical, chemical and biological damage during transportation, storage, distribution and display. There are many different types of package in use. The respondents were using sandark and wooden crates. The crates consist of rigid corners with planks nailed or stretched against those corners making them suitable for transporting produce for long distance. The respondents cited the following as advantages of using sandark and wooden crates: they have hard surfaces which give good protection to the produce and have good ventilation and fast pre-cooling is possible, can be manufactured and repaired locally and, reused and recycled (sandark crates) in order to reduce waste disposal problems. However, respondents felt that wooden crates were heavy to carry.

4.3.3.5 Indirect players: Support services rendered to smallholder farmers

The support service sector was dominated by the government followed by the Non-governmental organisation. All respondents indicated that they were getting services from government and non-government at one point. Most of the services which were provided were such as extension and credit facilities.

a) Government of Zimbabwe

Support to tomato production among smallholder farmers is through Agricultural Technical and Extension Services (Agritex) and Horticultural Research Institute (HRI). Agritex offers extension services and training to farmers in aspects of crop production and marketing and also assists farmers form linkages with suppliers and buyers of produce. Agritex, although with a limited budget and resources, is the institution with long term responsibility for irrigation operations in all the farming sectors in the country and is the key to sustainable interventions. With adequate funding, the institution has potential to assist farmers nationwide. Agritex provides supportive and logistical facilities to tomato producers, though little has been done in promotion of this sector.

HRI is one of the 15 research institutes in the Department of Research and Specialist Services of the Ministry of Agriculture, Mechanization and Irrigation Development. Its mandate is to conduct researches and disseminate production information, planting material and appropriate technologies on vegetables as well as their post-harvest management: Conduct public research in all vegetables, render advisory services to horticultural clients and stakeholders, farmer/ extensionists training and information dissemination. This entails production of fact sheets, production manuals, holding of field days, planning and review sessions and establishment of demonstration centers. In addition, other activities of HRI include registration of pesticides, issuing of pesticides import and export permits, discharging advisory services on issues pertaining to pesticides as well as conducting awareness campaigns on pesticides-related issues, regulating the distribution and sale of pesticides, fertilizers' registration, facilitate fertilizer importation, conducting awareness campaigns on issues pertaining to fertilizers and pesticides, inspections for compliance with the requirements of the Act and discharging advisory services on pesticide use and fertilizer use as well as lime applications. The office is also involved in the inspection of pesticides distributors and retail outlets.

b) Non Governmental Organisations (NGO)

They complement government efforts by providing farmer training in aspects of irrigation, environment and other social issues and facilitating government departments to carry out their duties. Although modalities of operation differ amongst donors, most of them provide

funding and equipment for irrigation through registered international NGOs, which in turn channel the funding through local partners who then implement the projects. The NGOs in turn assist in project planning and monitoring and provide training for local partners. There are exceptions to this mode of operations, as some NGOs implement projects directly with the communities.

c) Credit and Finance

For the ordinary smallholder tomato farmer, access to loans and credit facilities is not guaranteed as these are largely accessed from friends and family. Government policy is biased towards ensuring food security, usually at the expense of other crops such as tomatoes for the domestic market. The lack of collateral in terms of land was resolved by either group lending schemes (in which all members of the group were made responsible to repay the loan if one member defaults) or collateralizing (movable) assets such as cattle. Very few smallholder farmers have access to loans for tomato production. The major vehicle through which smallholder farmers were accessing inputs was through government-nongovernmental organisation partnership. The credit was mainly for inputs and usually provided as inputs instead of cash. The credit and finance sector is characterised by multilateral and bilateral agreements, commercial financial institutions, central and local government financing, commodity specific financing and micro-financial institutions.

i) Multilateral and bilateral aid

Multilateral and bilateral aid has been the most common forms of financing smallholder farmers in the study area. The government in collaboration with donors and NGO and communities established a credit facility called agriculture input support programme (e-voucher credit program) in 2012/13 season. This was the main source of credit for many interviewed smallholder farmers. This form of aid has come about through the recipient governments signing multilateral or bilateral agreements with aid agencies. Through this aid, also farmers benefited from large investments such as dam construction, irrigation facilities, machinery and other equipment. They also benefited from the transfer of technology and other softer sides of financing, such as management and organizational skills.

Cash has been sourced from Agribank. The cash is mainly used to meet labour payments. However, with the current emphasis on foreign currency generation, the Reserve Bank of

Zimbabwe and Agribank are seen financing all exportable products but with the commercial farmers as the biggest beneficiaries.

ii) Central and local government financing

Central governments have the role of ensuring that there is an equitable allocation of resources for development, especially of marginalized people. The government through its commercial banks made available an amount of $70-million in a credit scheme for farmers to access inputs. It was administered through government[4] owned commercial banks namely the Commercial Bank of Zimbabwe and Agribank at a 3 per cent concessionary interest rate. Credit has been subsidized, to some extent, for smallholder farmers, whereby the interest rates are lower than those charged for commercial farmers. These institutions provide short term, medium term and long term credit. Apart from allocating funds to its banks, government has made efforts to assist smallholder farmers by financing from their own resources programs such as: essential infrastructure for agricultural development, including dams, irrigation, roads and provisions of inputs.

Decentralization of functions to regional levels has resulted in the empowerment of the local authorities, including the allocation of resources for development projects. However, more often than not, the local authorities lack the necessary capacity to generate more income and finances in order to meet demand from their communities. In the end, they still rely on the central government. In most cases, both central and local governments are constrained in terms of resources and are unable to meet the financing requirements of the majority of

[4] The government of Zimbabwe owns Agricultural development Bank of Zimbabwe (Agribank) and Commercial Bank of Zimbabwe Limited (CBZ). The history of the Agribank dates back to 1924 with the establishment of the Land and Agricultural Bank in the then Southern Rhodesia. In 1971 the Land and Agricultural Bank was transformed into the Agricultural Finance Corporation (AFC). AFC was converted into a fully fledged Commercial Bank in December 1999 as Agribank. In October 2003 Government decided to transform the Bank further into an Agricultural Development Bank but with loan granting and deposit taking functions. The main mandate of the bank is to create and develop innovative financial products to reach a large number of farmers although it assumes other functions of commercial banks. Its strength is that it opens branches in rural areas although the one branch should serve an average number of 120 000 people per month. As of December 2012, the CBZ was the largest financial services provider in Zimbabwe, ahead of FBC Bank, Barclays Bank Zimbabwe, Stanbic Bank Zimbabwe and Standard Chartered Zimbabwe. The bank was founded in 1980 as the Bank of Credit and Commerce Zimbabwe Limited (BCCZL). The Government of Zimbabwe in 1991 acquired 100% shareholding in the bank to avert looming liquidation and was renamed Commercial Bank of Zimbabwe Limited. In 2004, bank was re-organized and renamed CBZ Bank Limited. CBZ Bank Limited became a subsidiary of CBZ Holdings Limited, whose shares are traded on the Zimbabwe Stock Exchange.

smallholder farmers.

iii) Commercial financial institutions

Commercial financial institutions comprise the conventionally accepted financial service sources, such as commercial banks and financial houses. The sector is characterised by 22 commercial banks, 4 building societies and 2 merchant banks. Two of the 22 commercial banks are owned by the government. The loans offered by these institutions are charged at market related interest rates and require loan guarantees in the form of immovable assets, shares, savings, land, etc. The average current interest rest is at 12 per cent making borrowing expensive for smallholder farmers. The environment in Zimbabwe would make access to working capital for farmers hard to come by because banks would not advance loans without collateral with a matching value. In this regard agriculture financing strategies was on the basis of cost recovery with a view of establishing the revolving fund. Due to these conditions, most respondents were not eligible for the loans and they were considered a high-risk group in terms of repayment.

iv) Micro-financial institutions

There are a number of self-help groups at the local community level that offer financial services in the form of savings and credit to the smallholder farmers. These organizations include the Self-Help Development Foundation (SHDF). Apart from the savings contributed by members, the institution is capitalized through loans and grants from donors. Only members have access to the loans, since their savings are used as collateral and the amount which members can borrow is severely limited. A number of non-governmental organizations operating at local community levels fall into this category of micro-financial institutions and most of them are funded through donors. They are also constrained by inadequate resources and are usually confined to offering short-term credit and technical assistance to farmers.

v) Commodity specific financing

Some companies engaged in certain agricultural commodities have resorted to financing smallholder farmers for a specific crop. One example is the Olivine Industries, which operates an input-credit scheme for tomato farmers. Loans are recovered from the proceeds of the next season's crop. This method of financing has proved to be effective for farmers.

4.3.3.6 Information technology and farmers

Information technology has evolved along with globalization, which is often associated with advances in communication and information technology. The way people throughout the world communicate, exchange information and learn about their world has changed as computer usage has become more prevalent in almost every part of the globe, further enhanced by the increase in the number of information technology-literate individuals. The influence of technology is also apparent in extension, especially with the transformation of traditional extension to information technology-based extension, or e-extension (Bondarouk and Ruel, 2009), as a result of the growing sophistication of information technology.

The respondents from government stated that Zimbabwe's Information communication technology (ICT) industry is rapidly expanding, but added that farmers in the country still needed to combat issues related to agricultural content. While the ICT industry is said to be growing in Zimbabwe, it is mainly the number of gadgets, phones, laptops and other hand-held devices that is growing and not the important asset content. Zimbabwe's mobile phone penetration has gone over 100 per cent, with 13.5 million active subscribers being registered by the close of 2013 (Postal and Telecommunications Regulatory Authority of Zimbabwe POTRAZ, 2013). The country's total population is 13.06 million, according to the results of the 2012 census. Active subscribers can exceed a country's population due to the accumulation of extra sim cards across the networks and a 100 per cent subscription level does not necessarily mean total subscription by the population. The country's largest telecommunications firm Econet, with just over 8.5 million subscribers, followed by Telecel with 2.54 million and NetOne at 2.45 million subscribers. Mobile phone use has grown phenomenally in Zimbabwe since the economy dollarized, from 3 million subscribers in 2009. A total of 5,202,993 data subscribers were recorded by December 2013, with 98 per cent of them accessing the internet using mobile phones. Internet penetration rose to 39.8 per cent by December 2013. The respondents suggested that to fill in this gap, there is need to gather, process, customise and broker agricultural content to help farmers with information and knowledge about markets. This would result in availability and accessibility of market information, which would benefit farmers.

4.4 Price behaviour

4.4.1 Seasonal price patterns

Table 4.12 shows the degree of price seasonality in Mashonaland East market. The price index at its peak point was found to be 1.367 in July, meaning that prices are generally 37 per cent higher than the annual average price. In contrast, the price index at its lowest point was found to be 0.717 and 0.718 in January and November respectively, meaning that prices are 28 per cent below the annual average price. In other words, the prices in the peak month are 1.9 times higher than in the lowest months. The high seasonal variation could be attributed to that, production and demand are seasonal due to climatic conditions, storage is impossible because of perishability nature of tomatoes and demand can be price-elastic.

Table 4.12 shows that the seasonal price index pinnacle tends to occur between May and July, the period characterised by low temperatures and sometimes frost creating unfavourable production conditions as tomatoes are cold sensitive, so may be affected by frosts. This causes supply to decrease pushing up price as demand increases due to decrease in backyard production. On the other hand, seasonal base is observed in the period runs between September – January, when there are optimum temperature ranges for the crop production. Therefore, it might be possible to predict that tomato prices are low in summer season, specifically in the month of October, November and December and high in winter season which begins in March and ends in August. By using the seasonality index to predict future demand, farmers should supply enough quantities in winter to take advantages of high prices. The results are consistent with the literature which shows that seasonality can be something that can work to farmers' advantage or disadvantage. It means; what can be grown and when. If a crop can be grown outside of the main supply time it can bring a price advantage. For example something usually grown in summer that can be produced in winter. Conversely something grown when it is most plentiful will usually bring a lower price although the crop may be at its best in terms of quality and ease of production. Climatic conditions are a major determinant of what can be grown and at what times of year. There are optimum temperature ranges for tomato crops. Crops are cold sensitive and may be affected by frost.

Since index suggests that prices increase in the winter season, farmers may decide to employ appropriate technology so that additional products can be produced. They can invest in

technology such as greenhouse to reduce effects of low temperatures. This enables farmers to grow tomatoes outside the main supply time as the strategy can bring a price advantage. In addition, the price indices showed to a decrease in demand during summer, farmers may cut production to meet sales goals or process surplus production.

Table 4.12: Seasonal Price Index

Month	Monthly Seasonal Index
January	0.717
February	0.877
March	0.915
April	1.125
May	1.317
June	1.203
July	1.367
August	1.131
September	0.946
October	0.785
November	0.718
December	0.851

4.4.2 Long-run integration

Tables 4.13a and b show the results for trace test statistics and maximum eigenvalue. The original data for six major tomato markets were first differenced to make them stationary. The maximum lag 2 was determined based on the AIC and Schwartz Criterion (SC). The results indicated that there were three cointegration vectors present which were confirmed by trace test statistics and maximum eigenvalue results. The results of λtrace connoted that the rank of Π could go up to 3 at 95 per cent level of significance. This showed that there were at least three co-integrating equations in the estimation. Therefore, the tomato markets were stationary in three directions and non-stationary in three directions since the trace statistics indicated that there were three co-integrating vectors and three common trends. This indicates that the tomato markets in six major regions during the study period were fairly linked

together; thus, the long-run equilibrium was stable. This finding is inconsistent with the study conducted by Guveya (2000) which concluded that the degree of market integration in Zimbabwe was poor in the long-run. As there was evidence of cointegration in this study, it was necessary to estimate the long-run β coefficients and the short-run α coefficients.

Table 4.13: Long run integration

a). **Trace Statistic Results**

Null hypothesis	Maximum Eigenvalue λ_{max}	Trace Statistic V_{trace}	95 per cent Critical value
$r = 0$	0.257	123.455***	104.37
$r \leq 1$	0.140	98.211**	86.08
$r \leq 2$	0.123	56.217**	52.05
$r \leq 3$	0.116	53.155**	33.76
$r \leq 4$	0.059	21.176	23.85
$r \leq 5$	0.040	08. 239	10.98

** Rejection of hypothesis at 5% level *** Rejection of hypothesis at 1% level

b). Maximum Eigenvalue Results

Null hypothesis	Maximum Eigenvalue λ_{max}	Trace Statistic V_{trace}	95 per cent Critical value
$r = 0$	0.247	153.455***	95.37
$r = 1$	0.130	78.122**	66.08
$r = 2$	0.121	51.117**	45.15
$r = 3$	0.105	31.155**	30.65
$r = 4$	0.045	20.295	22.85
$r = 5$	0.030	08. 419	10.93

** Rejection of hypothesis at 5% level *** Rejection of hypothesis at 1% level

4.4.3 Causality and integration of tomato markets

The results for causality tests are shown in Table 4.14. The results showed that there was a two way causation of prices between Mutare and Chiredzi and Mutare and Mbare. At 1 per cent level of significance the price shocks in Mutare Granger cause price changes in Mbare and Masvingo and those in Chiredzi at 5 per cent. However, at the 1 per cent level of significance price shocks in Chiredzi and Mbare Granger cause price changes in Mutare. This can be expected as Mbare is a major surplus region and Chiredzi is one of the tomato

deficit regions. There was bi-directional causality between Mutare and Chiredzi, and Mutare and Mbare. There was no Granger causality that was found from Mutare to Gweru and Bulawayo and from Masvingo to Mutare. This implies that Mutare to Gweru and Bulawayo and Masvingo to Mutare; Mutare leads the price formation process for only Masvingo. Thus, there is evidence to say that Mutare cannot be considered a central market. The results showed bi-directional causality with Mutare, Bulawayo and Masvingo and unidirectional causality from Gweru to Chiredzi and from Mbare to Chiredzi. Mbare has unidirectional Granger causality with Chiredzi, insignificant causality with Gweru and bi-directional causality with Mutare, Bulawayo and Masvingo. Gweru has significant unidirectional causality with Bulawayo, Chiredzi, Masvingo and Mutare. The relationship between Gweru and Bulawayo is expected since Bulawayo is a deficit region that relies on tomatoes from Gweru or imports from neighbouring countries such as South Africa. The results indicate that price changes in six municipal markets are complex as they are to be set around more than one market. Although Mbare is perceived as dominant fresh tomato market basing on the results there is no lead market whose price changes influence all other markets.

Table 4.14: Direction of price influence in tomato markets

Market	Mutare	Chiredzi	Mbare	Gweru	Bulawayo	Masvingo
Mutare		5.79**	6.77***	2.50	1.61	8.50***
Chiredzi	6.59***		1.11	1.51	3.64***	9.35**
Mbare	9.99***	6.25**		0.45	4.54**	10.73**
Gweru	11.88***	8.34***	9.75***		1.33	14.75***
Bulawayo	9.45***	4.65**	4.51**	0.97		8.50***
Masvingo	1.15	3.71*	3.55*	0.81	0.56	

Source: Agritex, Zimbabwe Farmers Union and Agricultural Marketing Authority
* Significance at the 10% ** Significance at the 5% and *** Significance at the 1%

The speed of adjustment and the length of time needed for prices to be transmitted from one market to another was analysed by dynamic estimating the price relationship between spatially separated markets specified in equations as follows:

MBARE = 0.22 + 1.020 Mutare + 0.310 Chiredzi - 0.346 Bulawayo *1*
(-4.521) *** (0.776) * (-1.776) *

MASVINGO = 0.45 + 0.828 Mutare + 0.335 Chiredzi – 0.157 Bulawayo *2*
(-3.545) *** (0.775) (0.667)

GWERU = 0.17 + 0.557 Mutare + 0.645 Chiredzi + 0.042 Bulawayo 3
(-3.851) *** (-2.265) *** (-0.385)

*** Significant at 1% and *Significant at 10%., All the figures in parenthesis represent t values

Equation *(1)* indicates that 1 per cent increase in prices in Mutare results in 1.020 increase in prices in Mbare whereas 1 per cent increase in prices in Bulawayo decreases prices in Mbare by 0.364. This implies that, as Bulawayo is a tomato deficit region and Mbare a tomato surplus region, the gains of price increases do not transfer from Bulawayo to Mbare. Due to the longer distance between Bulawayo and Mbare, price signals might not be transmitted accurately and correctly. Prices in Mbare increase by 0.310 per cent if prices in Chiredzi increase by 1 per cent. Equation *(2)* indicates that 1 per cent increase in price in Mutare results in 0.828 increases in price in Masvingo. Equation *(3)* indicates that a 1 per cent increase in price in Mutare results in 0.557 increase in price in Gweru and 1 per cent increase in price in Chiredzi results in 0.645 increase in price in Gweru. Due to the long distance between Chiredzi and Gweru, the result was not expected.

The short-run dynamics results from the VECM revealed that all the estimated short run coefficients except for four were statistically insignificant at the 5 per cent level. The coefficients' values ranged between 0.013 and 0.55. This suggests that the transmission of price changes from one market to another during the same week was weak. In co-integration equation 1, price changes in Mbare and Bulawayo during the studied period were transmitted to other markets at a rate of 20 per cent and 28 per cent, respectively, within a week. This evidently shows that it is often not possible for the farmers to obtain information on exact market prices in different markets. So, they accept whatever price offered by traders to them. Each producer is responsible for finding customers and obtaining information to guide him in bargaining over his price. In order to keep farmers abreast of market information, Agritex tries to collect current market information, but distribution in time is a big constraint. The adjustment toward the long run is slow in the case of price changes in Masvingo, Gweru, Mutare, and Chiredzi at 0.7 per cent, 5 per cent and 22 per cent respectively. However, only Masvingo at 36 per cent showed faster transmission and Chiredzi at 48 per cent showed faster adjustment.

4.5 Economic performance of supply chains

The VRS and CRS input-oriented results are presented in table 4.15. It was observed that the chain 4 that included wholesalers and processors was the only efficient chain when CRS was assumed. Chain 3, which involved supermarket, was efficient when VRS was assumed. Direct chain and the chain that included hawkers were inefficient under both CRS and VRS technologies. It was observed that chain 1 and 2 chains were on increasing returns to scale while supermarket chain was on decreasing returns to scale. Thus, chain 1, chain 2 and chain 3 were operating at sub-optimal scale level (scale inefficiency). Results indicated that input-oriented technical efficiency obtained for the CRS and VRS frontiers were, on average, equal to 0.82 and 0.93, respectively. Since technical efficiency scores were calculated as an input-oriented measure, the results implied that input consumption could be reduced by about 18 per cent without reducing the present produce level (at the present state of technology) under CRS. The mean scale efficiency was equal to 0.874. It meant that adjusting the scale of the operation, tomato producers could improve their efficiency by 12.6 per cent. This implied that farm scale issue is much less important relative to the amount of technical efficiency.

These findings were not surprising considering that many studies have found similar results about diffusion of suboptimal-scale-efficient farms among small holder farmers (Cisilino and Madau, 2007). The underlying rationale is that these smallholder farmers generally face capital, structural and infrastructural constraints. They usually do not have adequate farming implements or up-to-date technologies. The smallholder farmers that participated in this study were using traditional equipment such as the plough and hoe. Though the use and range of capital equipment used is increasing (such as tractors for example), access was limited due to the high capital investment required. High annual operating costs, availability of power and lack of adequate knowledge were additional constraints. Moyo *et al.* (1992) suggest that most dealers in such machinery or equipment lack commitment to service the small-scale sector as it is less profitable than the large-scale sector. Smallholders therefore, employ simple farming methods; agricultural tasks are usually carried out using hoes or draught power. The majority of farmers were found to be using the bucket and furrow systems, which are very tedious and inefficient, especially on larger plots. While this may have some benefits, for example when hoes are used instead of herbicides and therefore have less adverse environmental impacts, Muchena (1994) suggests that technological improvement is the only way Zimbabwean producers can establish and retain a competitive advantage in markets. Thiele and Brodersen

(1999) argue that market and structural constraints are among the main factors that usually impede achievement of efficient scales by part of farmers. Cisilino and Madau (2007) found that, often, the input mix is unbalanced (with respect to the rational and efficient composition of the input bundle) in favour of a high ratio of capital to land area and labour to land area. This should be mainly caused by a scarce flexibility in the land market, which forces farmers to expand the use of other inputs (except for land), especially labour and capital, with practical implications on the scale efficiency. Therefore, the presence of a quasi-fixed factor such as land should negatively affect scale efficiency and should favour exhibition of increasing returns to scale.

Table 4.15: Economic performance of supply chain

Marketing chain	CRS TE	VRS TE	SE
Chain 1	0.65	0.83	0.783 irs
Chain 2	0.75	0.90	0.833 irs
Chain 3	0.88	1.00	0.880 drs
Chain 4	1.00	1.00	1.00
Mean	0.82	0.93	0.874

Source: Survey data

Key: crste = technical efficiency
scale = scale efficiency
irs = increasing returns to scale
drs = decreasing returns to scale

4.6 Institutional Innovations

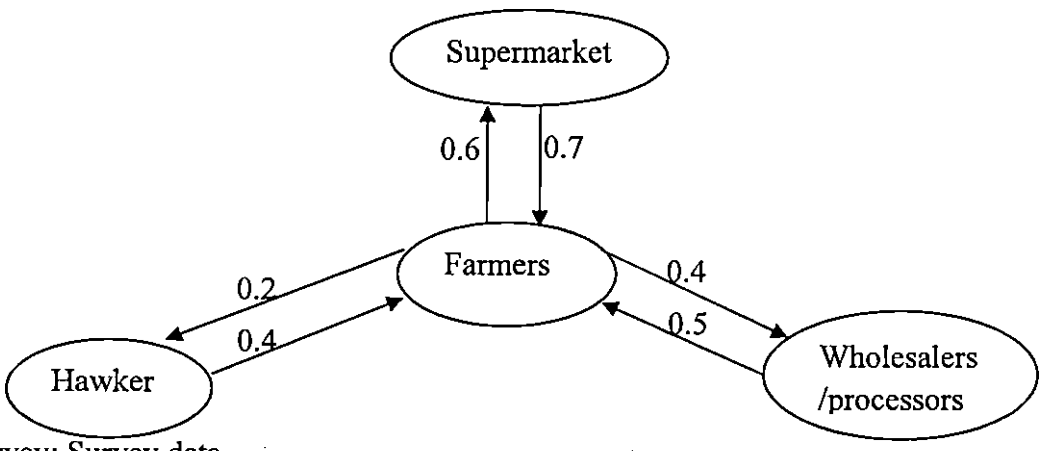
Nevertheless, it is clear that existing institutions, firmly rooted in the world of push, will require significant redesign in order to effectively harness the potential of pull. Institutional innovation, redesigning the roles, relationships and governance structures required to bring participants together in productive endeavours is a key requirement. In fact, institutional innovation will trump either product or process innovation in terms of potential for value creation. Thus, the section focuses on the institutional innovations in the tomato supply chain.

4.6.1 Level 1: Social embededness

4.6.1.1 Trust

The problem faced by smaller producers is often to access relevant production inputs and to find remunerative markets for their agri-food produce. This is where the trust and networks of individual platform members, in particular the traders and processors involved, can come in handy to serve the interests of producers and other supply chain members. Trust is a social capital formed between two parties enabling a more efficient linkage through the reduction of transaction costs. Whether or not trust is reciprocal can be particularly important to understanding the position of the farmers as it gives a rough idea of the extent to which an agreement is based on trust or simply the result of dependency (no other alternative partners available). Cronbach's α was computed for each subscale to provide an indication of internal consistency reliability and estimate the extent to which each set of scale items served as an indicator of a common construct. The score reliability estimates were high, ranging from 0.72 to 0.94; all were greater than Streiner's (2003) general rule of thumb for reliability (0.7). The group was composed of four actors namely farmers, hawkers, supermarkets and wholesalers/processors. Table 4.3 shows matrix of trust levels among chain players. The farmer trusts to hawker by value 0.2, trust value of hawker to farmer is 0.4. This indicates that both farmers and hawkers have no trust in each other; the exchange is therefore not reciprocated. Supermarkets trusts to farmers by 0.7, farmers to supermarkets trusts by the value 0.6. This means that farmers have some trust in supermarkets while supermarkets have high trust in farmers; the exchange is therefore almost reciprocated. The trust value of wholesalers to farmers is 0.5, and farmers trust to wholesalers is 0.4. The exchange is therefore little reciprocated.

Figure 4.3: Trust levels among chain players



Survey: Survey data

4.6.2 Level 2: Institutional Environment

4.6.2.1 Property rights

Motsi *et al.* (2001) attributed the failure of the smallholder schemes in Africa to substandard infrastructure, unclear irrigation scheduling and inefficient water use. According to Tafesse (2003), government policies on land tenure and water allocation do not create conducive environment for successful operation of smallholder irrigation schemes. Inefficient water use could be a result of poor, ineffective or absence of water management institutions. It is the goal of this section to trace some reforms as innovations citing strengths and weaknesses of water and land rights reforms.

4.6.2.2 Water rights and smallholder farmer in Zimbabwe

Water rights are mechanisms through which a user can access water for a particular use without jeopardising another user's right (Sokile and van Koppen, 2004). Water rights can be local or customary, i.e., means by which users may access water and establish allocation mechanisms among themselves without necessarily having a written document to define volumes and times for abstraction. Water rights are, however, mostly thought to be statutory, i.e., a blueprint document issued by the government, defining volumetric allocation of water and, sometimes, period for that particular allocation, and to whom it is provided for (Sokile and van Koppen, 2004).

Developments in water legislation and smallholder irrigation in Zimbabwe are closely linked with the country's socio-political history. In its simplified form this can be summarized in three phases. Between 1890 and 1980, the colonial state machinery favoured white settler political, social and economic interests at the expense of the black majority population. The attainment of independence in 1980 saw the post-colonial state seeking to redress the historical race, class and gender imbalances. Table 4.16 shows the main changes to the water legislation during the time agriculture became a dominant water user. There were quite number of clauses that disadvantaged the indigenous native population. First of all water rights were attached to land, which disadvantaged the natives who had been dispossessed and placed in the reserves where they did not enjoy full rights. Rights to land in the reserves were registered with Communal Area bodies (formerly known as Tribal Trust Lands) and not with individuals. Natives could therefore only apply for water rights as a community and through government officials. Even then the District Administrator or Minister of Water Development

held the water right on behalf of the natives. There was, however, provision for the appointment of representatives of native interests in the Irrigation Boards and in the Water Courts. Settlers on the other hand could individually apply for water rights because they owned land in their own private capacity. Another problem was that water rights were issued based on the priority date system; this meant that rights were granted on a first-come first-served basis. The Black indigenous people were disadvantaged because they had not applied for water rights (Manzungu, 2001). When they later understood this, most of the water was committed to rights held by the settlers. Water rights were also issued in perpetuity, which meant that a water right once issued could not be revoked except in special circumstances such as the declaration of a drought or when someone else applied for the same water and was willing to pay compensation. By virtue of the fact that settlers applied for the rights way before the indigenes, most of the water was committed. Although racial water allocation was provided for in the 1927 Water Act, it was only in the 1940s that massive transfers of water to the whites actually occurred because of cheap finance. This emphasises the argument that it is not necessarily changes in water legislation that determines (lack of) access to water.

Table 4.16: Main characteristics of water legislation between 1927 and 1980

1927 Act	1947 Act	1976 Act
• Differentiation of public and private streams	• Declared that all water other than private water was registered with the governor	• Clarified and created regulations about groundwater use for the first time. No restrictions were placed on drilling except in underground or surface water control areas.
• Differentiation of primary, secondary and tertiary use	• Reconfirmed that water rights were attached to land and not individuals	
• Created a Water Registrar and Water Court which centralized water allocation	• Private water was defined as 'that which naturally rises, falls or drains on to any land, provided such water is not naturally capable of entering any water course of natural origin'	• Rights to use, and permits for groundwater, were linked to land
• Required [all] people [using water] to apply for both a water right and approval of works to a Water Registrar	• Defined primary use as use for humans and animals and was set at 50 gallons (~228 litres) per day per person resident irrespective of colour or race, which can be used in gardens, for waterborne sewage purposes or other activities	• Required dams of a certain size to be registered, and design and construction to be carried out by a registered engineer
• Set up a priority right system for a drought year with applications given priority in order of time	• Clarified the rights of riparian landowners: 'They have the right, without any reference to the Water Court, to impound, divert or take any public water for primary use, and this right extends to any occupier or tenant of riparian lands. They also have, otherwise than in the public interest, a prior claim over non-riparian owners to be allocated by a Water Court for irrigation or other purposes'	• Required a riparian landowner intending to dam a public stream to notify all riparians downstream of the dam and contiguous to the dam
• Allowed recognition of 'combined irrigation systems' with Irrigation Boards that had certain rights and responsibilities in payments of development capital		
• Required registration of all dams storing over one million gallons unless for a primary right	• Redefined priority of use as, firstly, all primary rights, then rights for irrigation purposes (based on date of issue) and then tertiary rights	• Rescheduled water use types so that irrigation, fish farming and feedlots were registered as agricultural use

Source: Manzungu and Machiridza (2005)

The 1947 Water Amendment Act had loose allowances for primary water uses especially for irrigation/gardens users. The Act also defined vleis (*dambos* [seasonally flooded wetlands] or wetlands in depressions), springs and streams that stayed outside public management because they were defined as private water. This changed later with restrictions on *dambo* cultivation mainly because of fear of degradation, which had been noticed in the white farms. The Act also identified new water uses such as fish farms and conservation activities that were a result of new commercial interests.

The Water Act of 1976 affirmed the Roman Dutch Law concept in water management and upheld the principles of the 1927 Water Act i.e. rights to water were linked to land, the priority date system of allocating water and granting a water right in perpetuity. The Act also provided for catchment outline plans to be prepared for the development and use of surface water. Three types of water were recognised, public water, private water and underground water. The Act, under a 1984 amendment, also provided for some stakeholder participation in such institutions as River Boards. The participation was, however, restricted to water right holders. The Act also required applicants for water rights to put in place water measuring devices for a water right to be confirmed as permanent. This explains why most water rights in the native areas were temporary; the natives could not afford to put in the requisite measuring devices.

The system of water allocation in the colonial period was based on the matrix of ideas of efficiency, modernity, white power, male supremacy and the conception of starving Africans of land and water (Campbell, 2003). Campbell (2003) further argues that the planning mechanism of the settler state was organized around the concept of the scarcity of water. Politicians, agricultural extension officers, water resource managers, hydrologists, engineers, planners and economists propagated the concept of water scarcity when in reality the problem of water availability was one of democratic distribution and not availability. This was re-enforced by the myth of white supremacy, which was backed up in law and in the allocation of resources. Commercial agriculture was considered a part of the modern sector therefore commercial farmers were considered modern users of water, while communal agriculture was part of the subsistence and backward sector. Not much effort was made to make the black farmers aware even of the limited rights they had.

4.6.2.3 1998 Water Reform

Zimbabwe went through the 3rd process of implementing water sector reforms in 1998 and the reform was named 1998 Water Reform. The reforms have generally been driven by two major factors. Firstly, the general global concern pressing for a more efficient and sustainable water management approaches. One way of promoting more efficient and sustainable utilization of water is through stakeholder involvement in water management at the catchment scale. The idea behind this approach is to enhance greater participation at the catchment level, thereby increasing the sense of ownership among users and promoting sustainable and efficient use and environmental protection. Secondly, the water legislation was perceived to be inconsistent with present trends in Zimbabwe. More water users were applying for water rights, yet the existing legislation was not sufficiently flexible to accommodate more players. This was evident in highly committed areas, where almost all available water had already been allocated and therefore new users could not be accommodated. The 1976 Water Act was intended to protect the interests of commercial farmers, but these constituted less than 1 per cent of the country's population of 13 million (Manzungu, 2002).

The Water Act governs the use of water in Zimbabwe. Until the recent revision of the Water Act (1998), the prevailing act was the Water Act of 1976. In general, the Water Act of 1976 was a good piece of legislation that brought any form of water use under control and aimed at the systematic allocation of water among users. According to the act, anyone was entitled to access to water, as long as the water was for primary use (basic human sustenance). Any use of water from which the user would derive a benefit was deemed commercial use and required a water right. All water rights were issued in Harare by the Water Court, which was based at the Administrative Court of Zimbabwe.

The Water Act (1976) was amended due to global modern trends pushed for a review of approaches to water management in Zimbabwe. This led to the complete overhaul of the Water Act (1976), which was replaced with the Water Act (1998), conforming to global trends and addressing pressing national issues. According to Makurira and Mugumo (2006) the following were the main weaknesses of the Water Act (1976):

- The issue of all water rights was centralized at the Water Court in capital city Harare.

- A water right was issued in perpetuity on a first-come-first-served basis. This meant that when water resources were fully allocated, no further water rights would be issued, regardless of the need.
- In the event of water shortage, the process of reallocation was very long and complex.
- A water right would not be revised, even if the right holder was not exercising his or her water rights. The water rights could only be revised if the holder volunteered to do so.
- The process of acquiring a water right was very long. Once granted, there was no requirement to pay for the possession of the water right or to contribute towards general water service provision.
- The act was silent on water quality and factors relating to the environment.
- There was little consideration given to groundwater supplies. The Secretary of Water had to be informed if a deep borehole was drilled, but there was no control on the amounts of groundwater pumped or the number and spacing of such boreholes.

4.6.2.4 The Water Act (1998)

The following are its main features:

- Water rights have been replaced with water use permits. The permits are issued for a limited period and can only be renewed subject to water availability and evidence of efficient use.
- The priority principle has been done away with.
- Water can no longer be privately owned.
- Water is to be viewed from the complete hydrological perspective, i.e. groundwater and surface water are treated as part of one hydrological system.
- Stakeholder-driven institutions have been formed that will have more say on water allocation and general water management on a day-to-day basis.
- There is greater consideration of the environment, with environmental water use now recognized as a legitimate user.
- There is more control over pollution, with the polluter pays principle being introduced.

Water management has been decentralized to stakeholder-managed Catchment Councils (CCs) and Sub-Catchment Councils (SCCs). Under the present arrangements, a new framework for water management has been formed to:

- involve stakeholders in water management
- replace water rights with water permits, which expire after a set period
- create more efficient water allocation processes
- develop catchment water use plans, with the full participation of stakeholders
- treat the environment as a legitimate user
- form new stakeholder-driven institutions to facilitate more efficient water management

4.6.2.5 Water accessibility among smallholder farmers

Farmers under the study accessed water under customary law. Under customary law, Zimbabwe's water belongs to the land. All residents have the right to use water resources for domestic needs, irrigation, watering livestock and for use in activities such as brick-making. Customary law provides that local bodies such as water-point committees and village councils or village assemblies have authority to manage the community's water resources. In their absence water use is governed by traditional leaders such as chiefs and headmen. Community sanctions ensure compliance with established rules. In many areas, the traditional bodies continue to govern issues of day-to-day water access and use, with water-point committees reporting in some cases to Catchment Councils or sub-Councils. Whenever the volume of water in any river system or part thereof for the use of which permits have been granted proves insufficient to satisfy all the permits, the catchment council shall revise, reallocate or reapportion the permits upon such conditions and in such manner as will ensure the equitable distribution and use of the available water.

Zimbabwe does not have a national irrigation policy. National objectives for agriculture, including irrigation, are captured in Zimbabwe's Agricultural Policy Framework (ZAPF), which is effective for the 1995 – 2020 period. Policy objectives include: increases in irrigated areas, primarily targeting smallholders; equitable and efficient allocation of water resources; creation of water-pricing structures based on cost and social efficiency, establishment of improved institutional structures and implementation of drought mitigation plans.

Accessibility of water is also determined by nature of use as it is classified in the water act. Zimbabwe's water is divided into two categories commercial water and primary water. Primary water is defined in the Water Act of 1998 as water used for: (i) domestic human needs in or about the area of residential premises; (ii) animal life; (iii) making of bricks for private use; and (iv) dip tanks. In sum, it is not restricted to drinking water but seen as an integrated part of livelihood necessities such as food and housing in the communal areas. The state is obliged to respect and protect the right to primary water as embedded in the Act. What is meant by domestic human needs in and about the area of residential premises is, however, not clear. The Water Act (51.1) asserts the importance of primary water: No permits granted by a catchment council, other than permits for the use of water granted to a local authority for primary purposes, shall have the effect of depriving persons of the use of water for primary purposes. This makes provision for ensuring that primary water users will not lose any further water. However, to actualize this right means knowing how further water abstractions would affect primary users. No catchment in Zimbabwe knows the amount of primary water used because the catchment planning exercises, which were to make accurate estimates, have yet to be completed. In addition, there has been a loss of information on commercial water use. No volumes have been provided for primary water use. While a general national estimate has been made of rural primary water use, amounting to 1 per cent (Government of Zimbabwe, 2000), there are no detailed empirical estimates of actual use. It has been assumed that the amount of use has not justified registration in comparison with commercial water use.

4.6.2.6 Legal Institutional Framework

The Environment Management Act (2002) provides the legal foundation for the sustainable management of natural resources (including water), prevention of pollution and environmental degradation, preparation of national and other environmental management plans and custodianship of the country's environmental impact assessment policy. The Act provides for an Environmental Management Agency that has the power to advice on, plan and regulates matters of environment.

The Ministry of Environment, Water and Climate, establishes policies on water resource development. Several departments and parastatal agencies under Ministry of Environment, Water and Climate are involved in irrigation and water: the Department of Water

Development, Zimbabwe National Water Authority (ZINWA) and the District Development Fund. The ZINWA was formed with the primary role of taking over the commercial functions of the Department of Water Development. All fees charged for commercial water services are retained by the water authority for the provision of water services. Services of a statutory nature, provided by ZINWA are funded through the Water Fund, as directed by the minister responsible for water. ZINWA advises the Minister on the formulation of national water policies and standards and in conjunction with Catchment Councils, is responsible for the planning, coordination and management of national water resources and delivery. There are seven Catchment Councils, which represent all stakeholders in their catchment areas including both smallholders and large commercial operators. Catchment Councils (CCs) and Sub-Councils (SCs) prepare plans for the development and utilization of the water resources in their areas, create inventories and develop water-development proposals in line with the inventory of resources. CCs were established for the management of the demarcated catchment areas in Zimbabwe. A CC consists of representatives of lower-level catchment management institutions. The Water Act (1998) has also paved the way for better institutional coordination to facilitate more efficient water management. For instance, approval from several institutions is a prerequisite before a water permit can be issued. The theory behind the Water Act (1998) is commendable; however, when transformed to the reality on the ground, the practice is not always so successful.

4.6.2.7 Why have water sector reforms not performed as expected?

While the framework for a perfect water management system exists, the situation on the ground does not reflect this common belief. The reform process has not taken off as expected owing to a combination of factors ranging from conflicting policies and weak institutional linkages, to insufficient funding. The reasons given in the following subsections help to explain why a properly developed legal framework can only function with the support of other critical pillars, such as technical and institutional support.

New innovative forms of commercial cropping emerging within the common property regimes in the communal lands, such as gardening for consumption and sale, represent a challenge in how Catchment Councils, when issuing water permits, draw a dividing line between commercial and primary water uses. These uses render problematic the division between commercial and primary water. Under the new Water Act of 1998, it is only water

used for commercial purposes that requires a permit in terms of Section 34. The definition of commercial water depends upon use – water used for purposes including agriculture, mining, livestock, hydroelectric power, etc. It follows from the ZINWA Act, Section 41, which only permitted water is subject to the user pays principle in terms of the new water levy. Thus rural primary water users do not have to do so.

a) Donor withdrawal

The water sector reforms in Zimbabwe were largely donor-driven. Several donors pledged to support the reform process. This was very positive, considering that a particular donor would be supporting at most two catchments. There was therefore an opportunity for maximum interaction between the donor organizations and the beneficiary catchments. However, by the time the Catchment Councils were to be fully launched, only one donor remained available to support two of the seven catchments, and that donor was in the process of withdrawing its support. A number of stakeholders began to lose confidence in the whole reform process and they too began to pull out. CCs were not yet financially self-sufficient and this sudden withdrawal of donor support in both financial and technical areas was unexpected. Without a good financial base, CC activities were doomed to fail, with participation restricted to voluntary work. Volunteers tended to be those who had already established themselves in water management and therefore had interests to protect. Representation therefore continued to be skewed.

b) Land reform process

The launching of the water reform process coincided with the land reform process in Zimbabwe. The water sector reforms were aimed at promoting equitable and sustainable utilization with more participation of stakeholders and the introduction of the user pays principle. The land reform programme aimed to redistribute land and to encourage greater utilization of the national land resource. On paper, these two policies complemented each other. There was a great amount of movement, especially in the commercial sector, with established farmers moving away and new farmers coming in. This process happened so quickly that the water sector lost track of who was utilizing water. The problems were more complex in cases where there were more settlers on a property for which a permit had previously been issued to one user. The reallocation of such a permit to more users resulted in many conflicts. Moreover, new settlers were more interested in consolidating their claim to

the new properties than in attending water management meetings. Water issues were therefore thrown aside as the land reform exercise attracted greater attention.

c) **Financial stability**

The water sector reforms intended to implement the user pays and polluter pays principles. In this respect, permit holders would pay a fee, which was to contribute to water services provision. The Water Fund was created through the Water Act (1998) to facilitate the collection of levies, fees, government contributions and any other support towards water service provision. This was to be deposited into a common pool from where the minister would identify areas of greatest need for the benefit of the water sector. The government would also contribute to the Water Fund, using public funds allocated from the main government budget. The Water Fund had a potential to realise substantial revenue to be used to improve the provision of water services, as directed by the minister responsible for the provision and management of water. Inflows into the Water Fund have been minimal, with a contributing factor being the cessation of donor contributions. Unease ensued, resulting in many established farmers not paying for their permits, as they were uncertain as to their continuing occupancy on their land with respect to the new land reforms. Increased government responsibilities meant that less and less money was allocated to the Water Fund from the national budget. Similarly, new farmers were reluctant to pay for water use, as water rights had not been paid for previously. Most of the new commercial water users believe that water is a God-given resource and therefore there is no need to pay for access to it. The diminishing sources of contributions into the Water Fund therefore mean that there is very little money available to support water service provision and management.

d) **Weak institutional linkages**

The new Water Act provided a better framework for stronger institutional linkages. It is now a requirement that a number of institutions be consulted before permits for water use can be issued. However, there is little evidence to prove that this is bearing fruit. Not all institutions give priority to water issues. Some continue with their previous approach to water management where their support cannot be fully guaranteed unless they are certain of deriving substantial and direct benefits from their participation.

e) **Lack of capacity within key organisations**

Key institutions, especially ZINWA, are not adequately staffed to cope with the sudden demands for the provision of expert services. The staffing levels of ZINWA fall short of expected levels, as does the level of expertise. The result is that ZINWA cannot provide sufficient personnel to provide commercial services, nor can it provide statutory functions with funding sourced from the Water Fund. With staffing levels inadequate and depth of expertise questionable, it is uncertain if sufficient funds from the Water Fund would have made much difference to this situation. Other key organisations, such as the Department of Natural Resources and Agritex are also experiencing inadequate staffing levels that have a negative impact on the whole process.

f) **Lack of enforcement of legislation**

The new Water Act has been described as technically sound with a solid base for sustainable and efficient utilisation of water resources. However, some vital sections of the act have not been fully enforced, hence, its founding principles cannot be supported. The Water Fund is collecting insufficient revenue adequately to support statutory functions. ZINWA is not financially viable, as the four main accounts that were created (raw water account, clear water account, engineering services account and water levy account) are not self-sustaining, hence the new institution has to rely on the government for financial support. In the process, key and experienced staffs have left the organization owing to the working environment.

Similarly, Catchment Outline Plans (COPs) have not been developed in accordance with Section 12 of the Water Act (1998). COPs are to be developed by stakeholders and should serve as a guide on water management within their catchment areas, as well as on the interventions to take in the event of scarcity and therefore excess demand. Water quality issues and environmental aspects are also covered in the COPs. The reasons for non-development of the COPs range from a lack of capacity for their development, financial constraints and general lack of coordination among stakeholders.

In the meantime, water permits cannot be issued in the absence of approved plans and the objectives of the reform process cannot be fully realized. Water management representatives are from local authorities, industry, commercial farmers, communal farmers and other interested parties. While all representatives were expected to sit at the same table to discuss

water affairs, it was clear that the priority of each group was to protect its own interests. Communal farmers are the weakest and most disadvantaged sector, with the least appreciation of water for commercial use. They were not given equal access to the resource, despite management being conducted through SCCs, which were believed to involve such vulnerable user groups.

g) **Political interference**

Politics always plays a role in the success or failure of any process. In this case, there was a marked political influence in the pricing of water. In a bid to retain popularity, politicians aimed to keep the price of water as low as possible. Politicians frustrated the implementation of the pricing policy, which cannot afford to subsidize water service provision to maintain standards in good water service delivery. Defaulters of payments for water permits were protected against disconnection through the political influence of politicians. Political influence is also a factor in project choice and implementation where development is driven by political balance rather than economics.

4.6.2.8 Land property rights in Zimbabwe

All the different agents of the economy (public sector administrations, private corporations, small businesses, including farms, and individual households) at one point or another need fixed capital. With fixed capital, farmers gain access to financial markets and can borrow working capital for further investments. No financial institution lends without collateral. For this reason, fixed capital formation is a driving force for economic growth, development and the reduction of poverty and hunger. The crucial factors that allow for the formation of fixed capital are clearly defined property rights that are applied fairly and equitably to all under the rule of law and the presence of working financial institutions. Thus, land tenure remains the most important questions when dealing with agrarian issues world over. Land tenure is an institution, i.e., rules invented by societies to regulate behaviour. Rules of tenure define how property rights to land are to be allocated within societies. They define how access is granted to rights to use, control, and transfer land, as well as associated responsibilities and restraints. In simple terms, land tenure systems determine who can use what resources for how long, and under what conditions.

In an effort to empower the smallholder farmer community, the government redistributed eighty per cent of prime agricultural land under three different phases. The first phase of the Land Reform and Resettlement Program (LRRP1) by 1997 had redistributed 3.5 million hectares to 71,000 families from communal areas well below the initial target of 8.3 million hectares and 162,000 families. This phase is called old resettlement. A second phase of resettlement (LRRP2) begun in 1998, followed by an accelerated fast-track resettlement phase in June 2000, and then the announcement of an end to land redistribution was made in August 2006. The second face is called A1 farm model. Thus smallholder farmers are broken down using farm model as follows: communal farmer, old resettlement farmers and A1 model. In Zimbabwe different forms exist as per definitions given by (GoZ) including freehold tenure that is perceived as a sign of institutional innovations. The land is held by or under the authority of a title deed either by a private individual or institution, in which case it is private land under individual title or it may be held by the state directly or through a state entity under a title deed. Free tenure is regarded as superior in financial and commercial markets, simply because land can be transferred and thus provides certainty and stability in use of land for business purposes. Private businesses can mortgage land against financial borrowing, which means that the land becomes a guarantee for the finances borrowed for a defined period of time, and with clear interest on the money borrowed. In this ways, in the vent of defaulting on repayment of the finances, the financial institutions can recoup their money through repossession of the properties and reselling to get their money. This is the strength that Banks quote as providing tenure security for themselves. However, the results showed that few smallholder farmers (10%) were benefiting from freehold rights without outside interference, which became an envy of most rural elites. This means that it is predominantly the government which provide loans, for agriculture as it becomes evident over time that it's impossible to obtain credit without land as the collateral.

Land tenure is critical in Zimbabwe, simply because most resettled households have endured years of tenure uncertainty. Land rights have remained in the hands of the state, which has the prerogative to deny access or remove settlers at any given time. Farmers have diverse views and are behaving differently given that there are many uncertainties with respect to the land tenure in which they operate. At the present moment many have to make pragmatic decisions to succeed and to consolidate their stakes. Farmers are depending on a variety of means to secure their access to land, ranging from use of land, minimum use, abandonment, split

households and production systems (both in communal and resettlement areas), accessing state farming resources through legal and illegal means, using their resources from elsewhere to support their farming ventures. Many, for the fear of loss of land have to ensure that the land is under some level of use, but not optimum use that agriculture requires.

It is clear that the state should play a central role in land tenure issue. In fact international precedence shows that the state should have a right to acquire land for public purposes. Most national constitutions have this provision for the right of the state to acquisition based on public interests. In the case of Zimbabwe, there is this recognition; however a main worry of the farmers was that the state had contributed to their beneficiation, but still remains a strong force on the ground, which in a contradictory way contributes to tenure instability and mistrust, which then affects land utilization. Policy and legal reforms should be able to deal with this uncertainty because:

• In this case, respondents were of the view that every farmer should have the right to hold rights in property and to the extent that the nature of the rights permits the disposal of such rights. Government seems not to want this provision as spelt out in the offer letter, the 99 and 25-year leases. However, it has allowed for inheritance of properties based on customary systems.

• No deprivation of any rights in property shall be permitted otherwise than in accordance with a law. Yet, on the ground some people have been deprived of their land after allocation due to a variety of administrative errors, conflicts and weak political connections. The law should be able to fairly deal with these matters.

• The issue of compensation arises not just with respect to state acquired land, but also for any future land transactions. Policy should give guidelines, and this will need to be solved to address some of the conflicts.

Strengthening the tenure security of smallholder farmers, would provide a strong incentive for farm improvements and a more effective use of local land resources. The existing land tenure situation is felt as a major impediment to investment and farm development; it needs to be reformed so that smallholder farmers can compete equally with their commercial counterparts for additional resources. The reforms should also cover the village level institutions and the management of communally owned natural resources.

4.6.2.9 Credit facility (E-voucher)

This section provides the mechanism of the electronic voucher (e-voucher) programme mechanism in Zimbabwe which is part of institutional innovations. Zimbabwe is now cited as an example in other African countries due to e-voucher program. The Government of Zimbabwe, through the Ministry of Agriculture, Mechanization and Irrigation Development (MoAMID), launched a program to support small smallholder farmers in the form of agricultural inputs and extension (GoZ, 2012). The input support programme is being implemented through a partnership with Food and Agriculture Organization of the United Nations (FAO), various implementing partners, a technical provider and agro-dealers. The Food and Agriculture Organization of the United Nations (FAO) Zimbabwe as a major partner is supporting the agricultural programme through use of electronic vouchers to provide inputs. The electronic cards are open, allowing farmers the option to purchase agricultural inputs classified according to four broad categories: seeds, fertilizers and lime, agrochemicals and implements and spare parts for farming equipment. The program has minimum standards for various agricultural inputs, such as fertilizers, seeds, tools and acceptable agrochemicals. The availability of quality seeds and other inputs helps smallholder farmers boost agricultural production and incomes. The government of Zimbabwe perceive the program as an innovative approach that puts farmers in the driver's seat to move agriculture forward in Zimbabwe.

The programme is targeting 18 000 households. During the 2010/11 cropping season, 550 000 households received agricultural assistance from the humanitarian community of these, 339 000 households (62%) received inputs through the program. These sought to minimize direct input distribution, eliminate the provision of free inputs to farmers and fungibility.

The overall objective of Agriculture Input Support Programme is to increase production and productivity of small holder farmers in Zimbabwe, improving food security, livelihoods and on farm incomes. More specifically the objectives of the Programme are to:

- target surplus production beyond household food security requirements
- enable graduation from one socio-economic group to the next
- decrease dependency on annual input support programmes
- ensure efficiency of inputs use

Farmers are supported by Agritex, NGOs, farmers' unions and private companies through extension and training to improve productivity. The inputs are provided using rural input markets and the farmers contribute 10 per cent to the cost of the inputs they receive. Through the Programme, farmers access subsidized inputs, which are distributed wherever possible through rural agro-dealers using voucher mechanisms. The electronic vouchers are redeemable at competing rural agro-dealer outlets identified to participate in the programme. This empowers farmers to choose the agricultural inputs they need for the cropping season from a selection offered under the programme. Thus innovations are in two fold namely; brings input markets in rural areas and exploitation of information technology (use of e-voucher).

a) Key features of the programme

The partnership between Government, donors, NGOs and communities in implementing the 2011/12 Agriculture Input Support Programme aims to increase production and productivity of smallholder farmers ensuring surplus production beyond household food security requirements by:

- Providing farmers with access to agricultural inputs using subsidized voucher mechanisms
- Providing farmers with extension support to ensure increased agricultural productivity and optimum use of inputs
- Linking farmers with private sector companies in order to access output markets and to access credit facilities
- The private sector is encouraged to ensure that retail outlets have sufficient inputs for the exchange of vouchers for inputs and to meet the needs of farmers who are able to purchase inputs with own resources;
- The implementing partners will document procedures, processes, and monitor results from the Programme as part of building greater public and social accountability in the Programme during this and future seasons.

b) Beneficiaries for the programme

The Programme is targeting communal farmers, old resettlement farmers and small-scale commercial farmers. Zimbabwe is estimated to have about 1 524 396 smallholder farmers broken down as follows: 1 403 651 communal farmers, 107 625 old resettlement farmers and

23 120 small-scale commercial farmers. The Programme is targeting to support at least 870,000 households.

c) Guidelines for the provision of agricultural support

Two mechanisms are used to provide the input voucher to farmers: 1) the financial contribution from the farmer is paid at the agro-dealer outlet upon redemption of the input voucher. For each purchase made, 10 per cent of the value of the purchase would be paid for in cash by the farmer to the agro-dealer. 2) At the end of the season farmers make payment into a revolving fund which would be used to secure inputs for the next season.

- farmers receive vouchers worth US$400, redeemable at contracting private companies or agro-dealers (based on contractual agreements with the private sector)
- farmers make a 100 per cent repayment on the value of the inputs received at interest free and
- the support is based on credit guarantees enabling private sector to support smallholder farmers at reasonable costs (reduced interest rates), extension support, farmers' capacity building and contracting support. These programmes are implemented by private sector and NGOs, with the aim to link smallholder farmers to markets and enable them to generate surplus production and income from cash crop sales.

Distribution of inputs is done in a manner that supports the growth and development of markets in the rural economy. Wherever possible in areas where there are agro-dealers, distribution is done through these outlets to ensure that the local markets are supported. The distribution mechanism includes among others, the use of open and closed vouchers linked to agro-dealer networks. A combination of open and closed vouchers is used to adjust to market conditions and ecological zones.

The voucher system entails beneficiaries receiving vouchers that are redeemable at local retail outlets/agro-dealers.

These come in two forms: 1) these vouchers allow households to have freedom in the selection of goods. Open vouchers can be redeemed for crop inputs or livestock specific inputs. These vouchers have the additional benefit of supporting local/national suppliers and therefore a form of 'local purchase. The open electronic swipe card is the preferred type of

voucher dependant on the availability of network coverage and the network of agro dealers and wholesalers.2) Closed vouchers are used in areas where the network of agro-dealers and wholesalers is too low to support an open voucher system. Through the closed voucher system inputs are purchased through central tendering systems and distributed through agro-dealers.

Direct distribution is used only in circumstances where there is no market infrastructure to support the use of vouchers. Committees through existing structures from national to ward/village level play a critical role in supporting NGOs and communities in the distribution of vouchers to ensure transparency, accountability and non-partisan distribution.

Where direct input distribution is done, inputs procured whenever possible are ferried directly from source to the distribution points in the wards to avoid logistical bottlenecks related to moving inputs to central points in districts for further movements to distributions in the wards where direct input distribution will b done.

d) Monitoring and evaluation of the programme

A committee chaired by the Ministry of Agriculture Mechanisation and Irrigation Development is responsible for monitoring and evaluating the Programme. The committee works in conjunction with other committees at lower levels in the program which are as follows:

i) Provincial Committee

The provincial committee is responsible for:

The committee will oversee the implementation of the Programme at provincial level specifically in the following areas:

- facilitating the timely distribution of inputs in the province;
- coordinating logistical support in districts to ensure that inputs get to intended beneficiaries;
- providing weekly progress reports to the National Committee; and
- compiling a register of all provincial beneficiaries

ii) District Committee

The district committee is responsible for:

- compiling a register for the beneficiaries in the district
- ensuring sufficient support of extension services at household level
- putting in place logistic arrangements as advised by the Provincial Committee
- supervising, monitor and evaluate distribution and utilization of inputs at ward level and
- submitting weekly progress reports to the Provincial Committee and dates should be communicated to the Provincial Committee in advance

iii) Ward Committee

The ward committee is responsible for:

- compiling a register for all beneficiaries in the ward;
- working with NGOs and the community in identifying beneficiaries for the programme;
- supervising, monitor and evaluate distribution and utilization of inputs at household level; and
- submitting weekly progress reports to the District Committee

Extension services play a critical role in the effective implementation of this programme. The Department of Agritex is responsible for the provision of technical and advisory services for crop production. In addition the Department of Agritex provides the following services:

- monitor input utilization
- work in collaboration with the NGOs maintain a system of records detailing the following information province(district, ward, name of beneficiary, sex, identity number, vouchers/inputs received, date of receipt of inputs, date of planting)
- assess crop condition throughout the season and provide periodic reports;
- coordinate efforts of stakeholders at ward level including NGOs and other international cooperating partners; and
- ensure each participating farmer keeps an updated activity report similar to the Master Farmer record book.

Regarding the problems encountered with donor aid the following observations were made: Loan granting usually depends upon some macro-economic policies, as stable political and social environments of the recipient country. The moment these conditions are perceived by the aid agencies to be lacking, the aid is either suspended or withdrawn, regardless of whether the programs have been completed or not. There have been some cases where rural development projects have been prematurely and inefficiently terminated because of misunderstandings between donors and the government. These problems exist at both the policy level and the operational level. Some smallholder projects have collapsed when the donor pulls out. The farmers then fail to sustain the operations and good projects end up being abandoned because management skills are lacking among the farmers. Important issues pertaining to sustainability and institution building may not have been adequately addressed during project design or implementation.

e) Impact of credit facility on market accessibility

Credit was significant at 5 per cent level (Table 4.9). The odds ratio for credit were 12.32 meaning that the odds of participation in formal markets for smallholder farmers who had access to credit were 12.32 times greater than the odds for the smallholder farmer who could not access e-voucher credit. In terms of probability, the probability that the farmer who accessed credit from e-voucher would participate in formal market was 0.68 (Table 4.17). In other words, the farmer who accessed credit was 68 per cent likely to participate in formal markets.

Table 4.17: Impact of credit facility on market accessibility

Credit status	Probability
Farmer accessed credit	0.68
Farmer didn't access credit	0.22

Source: Survey results

4.6.3 Induced institutional ininnovations by farmers

4.6.3.1 Greenhouse

Green house production creates an ideal production environment that includes ideal relative humidity, temperature and light. These results in high yields, efficient water utilization, high fruit quality, prolonged production, shortened maturity period, low pest and disease incidences, reduced use of land to achieve the same results i.e. ratio of about 1:10, low labour input and timing of market.

Majority of respondents learnt the concept of greenhouse farming from non-governmental organisation. The tomatoes on average take three months to mature. Majority of respondents indicated that they set up their greenhouse on a $200m^2$ piece of land. The capital including the greenhouse and the drip pipes was expensive, as the cost was at $3 800. They planted 400 tomato plants and the success rate of these plants was 100 per cent. Each plant gave the farmer 10kg of tomatoes that would translate to four tonnes. The respondents were able to recoup the first investment from the sales in the first season. They added that managing greenhouses was also cheap and less time-consuming.

Greenhouse was statistically significant at 1 per cent significance level (Table 4.9). This is sufficient evidence to support that the farm infrastructure (greenhouse) is likely to influence smallholder farmers to market their produce through formal channels. The odds ratio value was 18.45 meaning that the odds of participation for the smallholder farmers who have greenhouses ($200m^2$) are 18.45 times larger than the odds of participation in formal markets for the smallholder farmers who do not have green houses. An increase in one unit of greenhouse is associated with 1745 per cent increase in odds of participation in formal markets. In terms of probability, the probability that the farmer who constructed greenhouse ($200m^2$) would participate in formal market was 0.647 (Table 4.18). The chance of participating in formal markets is 64.7 per cent. The reason could be that most farmers avoid growing the crop during low temperature seasons due to lack of facilities like green houses. This causes them not to constantly supply tomatoes resulting in their expulsion. This is supported by researches conducted by International Fund For Agricultural Development (IFAD,2003) and World Bank (2008) which showed that smallholder farmers face barriers to accessing emerging restructuring markets because of poor infrastructure in rural areas. If the

farmer doubles the size of the green house ($400m^2$) his/ her probability of participating in formal markets becomes 0.82. This means that his chances of participating in the formal market will increase by 17 per cent compared to the farmer who owns $200m^2$.

Table 4.18: *Impact of greenhouse on market accessibility*

Farmers' status	Probability
Own green house	0.647
Do not own greenhouse	0.21

4.6.4 Level 3 Institutional governance and conduct

4.6.4.1 Production and Marketing strategies

Market intermediaries and farmers have usually been at odds with each other, in spite of the interdependence of the two. The multi-faceted relationship between farmers and the intermediaries in the market for their produce facilitates both horizontal and inter-temporal transactions. However, the arrangements do not always work for the best. The search for the appropriate institutional innovations for agricultural markets continues. The wide variation in the distance between consumer markets and the location of producers has meant that no single model of market intermediation is likely to be successful for all commodities. Competing in the high value markets has required a further set of regulations and institutional structures for taking the produce through high value markets. While a large share of the produce comes from a small percentage of farmers, market institutions must also serve the large proportion of small producers. This has been the main challenge in designing agricultural market institutions. Thus, this section covers the market mechanisms used in the tomato markets between smallholder farmers and buyers. In the study area contract farming was noted as a sign of institutional innovation type under marketing arrangements. Contarct farming was observed in the formal market between farmers and supermarkets and farmers and wholesalers.

4.6.4.2 Contract farming

Two types of contract farming were established in this study; informal and formal contract farming which are discussed below.

a) Informal contract

The results show that the contracts established between supermarkets and farmers were often by the word of mouth and were seldom written up as formal agreements. Approximately 95 per cent of respondents supplied supermarkets were informally contracted by the supermarkets. The other 5 per cent had formal binding contracts. The supermarkets enter into seasonal contracts, often on a verbal basis, with a limited number of farmers. Supermarkets indicated that informal contract was the best market mechanism as they wanted limited amount of tomatoes from farmers. The supermarkets with verbal contracts did not see the need to sign contracts since that was going to increase its transaction cost and besides the verbal contract was working well. They were buying small quantities of tomatoes (100kg/week) because part of their purchase was imported or coming from their farm as per their policy. Farmers were responsible for grading and weighing the crop on the farm. However, all supermarkets were inspecting the grades and making final decision about the grade of the crop at company site.

Although literature stresses that farmers' benefit from contractual terms such as inputs, in this case farmers expressed that their success was partly relying on the extent to which other providers (such as the state and/or NGOs) could offer inputs, extension and credit as supermarkets rendering minimum support. Demand and supply in the market however, determine prices for produce at the point of sale. While most smallholder farmers opted for cash payments upon delivery of their produce, the majority of them had to wait for payment being made in the fortnight following the sale. Small-scale farmers are restrained in their access to capital and cannot afford to wait such long periods before payment. The advantage to the smallholder farmers was that if they were not happy with the price offered by supermarkets, they were free to sell their produce elsewhere. Supermarkets gave priority to scheduled producers who have the option to accept, the price on offer. However, According to Eaton and Shepherd (2001) due to its non-formal nature, this model often suffers from extra-contractual side-marketing. The respondents pointed out that since the contract was based on verbal agreements, the interpretation of responsibilities and specifications was a major problem. Confusion and misunderstanding could easily occur as the agreements were not clearly explained by supermarkets to the farmers and their representatives. The supermarkets' field extension staff must have a clear understanding of the terms of the agreement.

b) Formal contract

All wholesalers had formal and legally binding contracts with smallholder farmers. The prices at which produce was bought were set at the time the contract was entered into or on monthly basis depending on contacting company. Wholesalers/processors set prices for produce on a monthly basis. This was done with the hope that such prices would realistically reflect those prevailing on the market at the time of selling. Again farmers faced the risk that the prices might fell possibly result in losses. The adjustment of prices was done in order to reflect the trend. Before the farmers were contracted, wholesalers/processors determined when the market prices were likely to be highest. They, therefore, asked the farmers to plant the crop at such a time as to enable it to be harvested when the highest prices were obtainable on the market. A bulk cheque was issued to the whole group once produce had been graded. In addition a print out was also produced to show what each member of the group was supposed to receive. Hortico told the farmers what grade they would have achieved as well. For transparency, this was done in front of the farmers, therefore, the farmers had the opportunity to assess the fairness or otherwise of the awarded grade. Payment was based on the grade obtained. However if the grading system was not explained to all the participants, some farmers might be left wondering whether they would be getting a fair deal. A typical example is Mutoko Communal Area which delivered tomatoes to Selby Enterprises. Out of the 300 members of the irrigation scheme only a few representatives were taken to Selby where the grading system was explained. The outcome of the visit was not explained to the rest of the farmers, as a result the majority of the farmers felt cheated due to the variation in the amount of money they received for the same weight of tomatoes sold. While this was based on the grade achieved by each farmer's consignment, farmers remained doubtful about the manner in which produce was valued. Farmers were not pleased to have their produce graded in their absence. They thought that the companies could take advantage of their absence and award them inferior grades. It was difficult to verify whether companies actually practice this. However the companies indicated that they would want the farmers to realise the merits of producing high grades so that they would strive to improve on their management practices further. This would be beneficial to the viability of the company. Some cases of contracts are given in box 1 and 2.

Box 1 A case of Cairns Food

Cairns Food is involved in contract arrangements directly with small-scale farmers. The smallholder farmers who are contracted to Cairns work in groups of between 20 to50 farmers, where each group has a committee structure. Cairns Food deals directly with the committee rather than with each individual farmer within the group. Producers typically crop one hectare of land under contract with the company. Cairns makes an agreement with the committee to buy produce from the farmers provided it meets the quality standards laid down. The names of the members of the group are also attached to the contract. Cairns Food expressed that making one contract for a group of farmers reduces the administrative costs for the company. Cairns Food provides farmers with seeds, fertiliser, chemicals and transportation in order to ensure that the produce reaches Cairns as fresh as possible. In order to ensure that crops are grown in strict adherence to the required standards, extension officers (from Cairns Food) work closely with farmers providing them with necessary technical assistance at each and every stage of the production process. Cairns Food has three main methods of payment to smallholder farmers:

- Cash upon delivery of produce, less 8 per cent early settlement discount
- Cash payment after 14 days, less 5 per cent early settlement discount
- Cash or cheque payable on the 22nd of the following month after delivery, i.e. Normal days. Full payment of invoice is made without a deduction or discount.

Cairns expressed its anger over farmers, for instance the 2012 tomato crop was not particularly good throughout the country due to the excessive rains which were experienced. As a result demand exceeded supply. Farmers who had managed to have a mature crop soon after the rain season could fetch U$$1,500 per tonne in Municipal markets. In comparison to the U$$700 which they had been contracted by Cairns, most farmers ended up delivering the contracted crop in Municipal markets. As a result Cairns had decided not to renew contracts with smallholder farmers in Murehwa. Cairns were well aware that there was very little they could do if farmers defaulted on the agreement signed. The costs of suing the farmers would not be justified by the benefits. However some companies other than Cains were also capable of defaulting on contracts. When this happens the farmers do not have the necessary resources to sue the companies.

Box 2 A case of Olivine Industries

Olivine Industries have an agent who contracts farmers on the company's behalf. A written agreement is entered into between the company and the group of farmers through the group chairperson on annual basis. Although the contracts are signed, the company says that this is only a loose agreement and no action would be taken against the farmer for not complying with it. The agent conducts regular visits to the farmers. The agent is paid by Olivine Industries on commission. This arrangement was thought appropriate due to the long distances involved. The company for example contracted farmers in Ngondoma Irrigation Scheme to produce tomatoes. The scheme was distant to the company's factory. Therefore it was possible to monitor production by the contracted farmers since the agent was from same area with farmers, thus cutting transaction costs.

The company prefers to get a request to enter an agreement with producers to originate from the farmers who would have realised the need to produce and market through Olivine Industries. Such farmers are likely to put maximum effort in producing the crop. In addition the company considers 0.2 hectares per farmer as the minimum area viable for a contract to be entered into.

The company provides the following services:

- ✓ extension advice in conjunction with local Agritex extension workers
- ✓ collects the produce from the growers
- ✓ sells to farmers the seed of the varieties that they would like to grow and fertilisers
- ✓ buys and sells at cost price.

Payment is made within two weeks by cheque. Cheques are issued to individuals. The company works with a fixed price on a monthly basis. Each farmer's delivery is evaluated for quality at the company's premises. Payment is based on the quality and quantity that each farmer supplies.

The company provides transport which picks the produce from the farm. Each farmer's produce will be clearly marked. If farmers were to provide their own transport, they are compensated accordingly.

The farmers indicated that the middle person approached them as if she was employed by Olivine Industries. She comes to an agreement with the farmers that the company, through her, was to supply seed (Heinz), fertilizer and chemicals while the farmers would produce the tomatoes and sell it to Olivine Industries. According to the farmers the seed was delivered late, the fertilizer was delivered but no chemicals were supplied. It also turned out that the seed was of poor quality and succumbed to disease pressure in the area. Without any chemical control the yields were very low since there was a strong attack of bacterial wilt. The farmers were of the opinion that they could not use their own chemicals since the crop was being grown on contract. Due to her inability to travel to the irrigation scheme from Harare, it took her considerable time before she could visit the scheme again, by which time the bulk of the crop had been adversely affected. The middle person was of the opinion that the farmers at the scheme were not very progressive as evidenced by their leaving the crop to be destroyed by the disease without taking any control measures. In her opinion, had they been concerned they would have sought expert advice from Agritex officers in the area. In addition some of the farmers used the fertiliser given to them for tomato production on other crops other than the tomatoes.

The farmers also alleged that it later became clear that the middle person was doing everything for a 15 per cent commission to be deducted from the prices the farmers were supposed to receive. Most of the farmers therefore opted to sell through other avenues. They were fetching $0.95 per 10 kg. This resulted in a much higher income that the $7000 that Olivine would have paid if they were selling directly to the company. Selling through the middle person was to result in lower revenue.

The farmers were of the opinion that the experience was unfortunate and was caused by a lack of clarity of the full details of the contract. As proof that they were willing to produce on contract, they cited what they had experienced by growing baby corn on contract for Hortico which they could only be described as a success story. The company kept in contact with the farmers such that they produced a very good crop. The company collected the baby corn from the irrigation scheme. The fact that large-scale companies contract smallholders to grow produce and entrust them with their inputs, and the fact that many small-scale producers are meeting the standards and quotas laid down, is indicative of the

latter's productive potential when provided with inputs and technical support.

4.6.4.3 Collective action

Two farmers' organisations were identified in the area of study namely savings groups and irrigation cooperatives.

4.6.4.4 Savings Groups

Savings groups in Zimbabwe are being actively promoted by international development agencies including Cooperative for Assistance and Relief Everywhere (CARE), Catholic Relief Services, Oxfam America and Plan International and others including national and local partners. Savings Groups (SGs) refer to self-managed community-based groups that provide their members access to basic financial services. In the area of study CARE was the dominating facilitating agent. CARE International's programme in rural Zimbabwe promotes access to basic financial services combined with support to farmers for accessing agricultural input and output markets. In 1998, CARE Zimbabwe launched the Internal Savings and Lending (ISAL) project, using a community-based SG approach for the delivery of basic financial services. In 2004, CARE Zimbabwe introduced the Agent Project to areas of the ISAL programme while the ISAL methodology was introduced to the farmer groups established under the Agent Project. SGs are composed of 15 to 25 self-selected smallholder farmers who meet regularly (usually weekly or fortnightly) to save and, if desired, borrow for short periods, paying monthly interest at a rate (average 20%) set by the group. The respondents (85%) indicated that their SGs don't allow members to save different amounts. Savings are maintained as a loan fund from which members or non-members can borrow in small amounts. After approximately 12 months, all savings and earnings are distributed back to group members (often referred to as a share out). The earnings usually are distributed in proportion to their savings. The members of the management committee are elected democratically and annually and all groups had a constitution, which was usually written down and kept by management committee and CARE officer. All transactions are carried out in front of the members and recorded and records are kept by management committee. The role of CARE as facilitating agencies is to train the savings groups to carry out their transactions independently and monitor progress. Training covers all aspects of group func-

tions, from developing a group constitution and electing group officers to establishing meeting procedures and rules governing saving, lending and record keeping. CARE considers savings groups to be independent when they are able to run an organised, disciplined meeting, maintain accurate records and manage their own share-out or dividend distribution.

Aga Khan Development Network (AKDN, 2010) provided evidence that Savings Groups enhance the capacity of small-holder farmers to purchase agricultural inputs in Zimbabwe. However, the evidence is less clear that linking Savings Groups to local agro-dealers through the Agribusiness Entrepreneur Network and Training (Agent) Project resulted in a direct increase in the purchase of agricultural inputs. The respondents expressed their concern over sustainability of savings groups due to poverty and they are not recognised by the government as they are informal groups. They cannot access loan from government bank like co-operatives. This is consistent with the literature which indicates that the problems faced by less developed countries in the field of agricultural innovation are of a varied nature. On the one hand, there is a relative shortage of resources (human and financial) and technological gaps; on the other there are organizational failings that amplify the lack of resources (Jimoh, 2011).

4.6.4.5 Financial performance of savings group (reliability)

The normalised value of financial performance was 0.386 which is less than one. This means that most of payments were delayed. This is a threat to sustainability as members of the savings groups are not able to pay back on time. In other words it means that farmers cannot rely on such sources of finance for their farming business.

4.6.4.6 Irrigation cooperatives

Irrigation cooperatives were identified as institutional innovations. The cooperative movement in Zimbabwe dates back to 1909, when the Cooperative Agricultural Act was promulgated to facilitate the formation of marketing and supply cooperatives by commercial farmers. Since Independence, the Government of Zimbabwe has promoted cooperative development in several ways by: (i) preparing new cooperative legislation; (ii) providing a long-term basis for cooperative development through preparation of a Cooperative Policy Paper in 1983 (iii) gradually increasing the governmental staff to support and supervise cooperatives and (iv) establishing a separate ministry for cooperatives in 1986 (which,

however, was combined with another ministry at the end of 1987). Another significant development after independence was the introduction of the concept of collective cooperatives

While there have been an increasing number of registered agricultural cooperatives over the last few years in the Zimbabwe, the large number of cooperatives is not functioning to full capacity and some have stopped production completely (GoZ, 2012). About 40 per cent indicated that they belonged to irrigation cooperatives which were Takunda and Rujeko. These irrigation cooperatives were partially functional. The cooperatives were production based; they played roles such as providing extension, inpu and training. They were providing minimal marketing functions.

4.6.4.7 Participation and Management in the irrigation cooperative

The irrigation cooperatives studied were varying in size, the smallest irrigation cooperative had 5 hectares (ha) and the largest irrigation cooperative has 50 ha. While land was jointly owned, in all interviewed cooperatives, each farmer had his/her own allocation within a large garden area. The number of plot holders in each cooperative also varied depending on the allocated plot size. The plot sizes varied from 0.3 ha to 1.55 ha. The cooperative with the lowest and highest number of beneficiaries had 16 and 168 farmers respectively. In all 10 cooperatives there was restriction on the number of members. About 50 per cent of the agricultural cooperatives under the study was initiated by the government in its endeavour to provide the farmers with a source of self-sustenance. The farmers did not actually request for the development of the irrigation cooperatives. The farmers did not make any financial contributions towards the development of the projects but participated only as hired labour. The other half was initiated by non-governmental organisation and farmers. The farmers or non-governmental organisation identified the project and approached the government for assistance. The farmers made contributions towards the costs of the infield development.

In terms of management the results showed that 50 per cent, 32 per cent and 18 per cent of the irrigation cooperatives were farmer managed, government managed and jointly managed respectively. For jointly managed cooperatives the farmers and the government shared the financial responsibility for the operation and maintenance. For such irrigation cooperatives

the results of the study showed that government was usually responsible for the water supply, while farmers took responsibility for the infield infrastructure.

Although interviewed cooperatives showed that they had different types of management, all cooperatives managed their activities through the establishment of management committees. Each committee on average had seven members whose positions were chairperson, vice chairperson, secretary, vice secretary, treasurer and two Committee members. The management committees used a system of bye-laws to manage and run the cooperatives. Farmers were assisted by support institutions to draw up constitutions, which became the irrigation management reference resource. Constitutions, regular meetings, minutes of meetings and records of activities were some of the tools used in the management of irrigation cooperatives. Local leadership also assisted in enforcing the rules of the constitution. The specific responsibility of management committee depended on the type of management. Approximately 78 per cent indicated that management committee was responsible for the overall management of the cooperative whilst 32 per cent showed that the management committee was responsible for linking the cooperatives with various institutions.

The farmer managed irrigation cooperatives indicated that the organisational structure was designed in such a way that the members were supreme organ in the organisation with ultimate decision making powers. They indicated that they had the right to use or to direct the use of the property. The farmer managed cooperatives showed that the members who were also labour suppliers were the owners and hence had the right of control. The members themselves finance investments in a cooperative enterprise therefore, obtained the right to control. The farmers indicated that they democratically participated in cooperative's management and all the members were equal with respect to voting rights and the right to be elected onto the cooperative's management body as they controlled on the basis of one member one vote. Therefore, they had the right to control as they provided the capital which gave them the rights to control. The cooperatives structures reflected the relationships and roles amongst the general membership and their respective leaders.

In the government and jointly managed cooperatives, farmers showed that the ultimate powers were vested in the executive committee and more so in the chairpersons. The farmers

in government managed irrigation cooperatives viewed their cooperatives differently from the farmer managed irrigation cooperatives. They felt that the projects did not belong to them but to the government. The farmers indicated that by forcing the cooperative members to recruit leadership not of their own choice, the environment created entry for incompetent non-committed opportunists and other corrupt people into the cooperative. In addition, the fact that they were not consulted by local authorities on whom and when to resettle new farmers on abandoned plots was demonstration of their attitude. However, some members from government managed cooperatives indicated that the irrigation cooperative belonged to the government as far as irrigation equipment was concerned but the land belonged to them. They believed that if they had contributed towards the development of the irrigation cooperatives they would strongly regard the projects as theirs.

The transfer of assets within the cooperatives under investigation was severely limited. As regards inheritance, the plot holders at all the cooperatives showed that their partners inherited the plots in the event that the registered spouse died. However, the question of inheritance was not clear in the transfer of the right in cases where there were polygamous marriages.

The members of the jointly managed cooperatives felt that they had no full autonomy of running the cooperatives. This was because the farmers and management committee had no right as to who joined the project so they had no reason to believe that the irrigation equipment was theirs. According to them, nobody informed them about what belonged to the farmers and what did not. Therefore, management committee under jointly managed cooperatives was only related to the operation and maintenance of the irrigation infrastructure.

Farmers under government and joint management type complained that poor farmer selection was affecting the performance of the irrigation cooperatives. The farmers felt that the selection of plot holders was not stringent enough to screen those who are not committed to irrigation. The uncommitted group was reported to be responsible for the poor performance of the cooperative by failing to pay the operation and management costs on time. Irrigation cooperative attracted members which were political motivated and they tended to influence decision making.

The results indicated that the farmer managed cooperatives had few problems compared to government and joint management in maintaining their irrigation system. They collectively raised funds to carry out the operation and management work necessary. Although farmers were capable of maintaining the cooperatives, they had problems with their imported pump. Spare parts for the pump were difficult to find and as such the irrigation cooperatives could go for several months without irrigation following just a minor pump breakdown. In addition, they faced challenges such as vandalism from those who were not members, too many contributions was reported to frustrate participants and perpetuate internal disagreements that had negative effects on development in decision making.

In the case of the government managed, the operation and maintenance of infrastructure was not adequate. The operations and maintenance costs were reported to be eroding some farmers' income as evidenced by the failure of some of them to contribute towards the costs of energy and repairs on time. There were always delays in repairing the equipment whenever it broke down. Electricity was frequently disconnected by the Zimbabwe Electricity Supply Authority (ZESA), due to non-payment of the bills. The bill consumed approximately 25 per cent of the budget allocated to Agritex for managing and operating all the irrigation cooperatives in the country. This was not enough given that more cooperatives required a share of that budget. The farmers were reluctant to accept this responsibility and they accused the planners of producing a complicated design that could not be managed by the farmers themselves. Pump breakdowns were common and the infield hydrants were leaking. The government was failing to provide adequate maintenance.

When performance of each of the studied irrigation cooperative was examined in relation to farmer involvement during planning, it appeared that all the schemes in which farmers participated during implementation were doing very well. However, although the farmers participated during construction, there were other problems which outweighed this element of participation, hence the poor performance of the irrigation cooperatives. The confusion on land allocation had a lot of bearing on the performance of irrigation cooperatives. Some plots have been subdivided to benefit the children of the people who claimed to be the real beneficiaries of the irrigation cooperatives. Those who felt to be the real beneficiaries were the ones with the land which was taken as part of the irrigation cooperatives.

Water savings were observed to be better at farmer managed cooperatives than at any of the government managed schemes. This can be attributed to the electricity charges which farmers were paying at the farmer managed schemes. They believed that the cooperative existed as a result of its members' efforts. The charges compelled the farmers to be more responsible and efficient in using water. The reason for this could be that the farmers wanted to raise enough money for operations and maintenance purposes. All farmer managed cooperatives grew tomatoes throughout the year. At the government managed cooperatives water management was very poor because farmers did not pay for electricity and water bills.

In the government managed cooperatives, it appeared the production was intensified during summer season. Crop yields obtained in the various irrigation cooperatives seemed to be related to the planning stage of the scheme. Those irrigation cooperatives in which the farmers were against irrigation development at the planning stage seemed to be performing badly in terms of yields. Farmers who felt that the schemes belonged to them are committed and are producing good yields.

All farmer managed schemes that were producing throughout the year had organized marketing structures and strategies. They hired transport collectively and go to the markets as a group. For example one cooperative was contracted by supermarkets. The cooperatives that showed to concentrate on intensify production in dry summer preferred buyers to come to the scheme. The quality of their produce was poor in most cases meaning that they could not compete fully in the lucrative markets. The other reason why they did not make an effort to exploit the lucrative markets was that they were not paying for operation and maintenance costs. It is highly probable that once they start paying for these costs they will undergo a complete transformation.

All the ten schemes hired labour to assist in land preparation, weeding and harvesting. Payment was in cash and/or in kind. Schemes that grew throughout the year generated much more labour than schemes that concentrated on intensify production in summer. This means that farmer managed schemes, which produced horticultural (tomatoes) crops, provide more labour than government managed schemes.

4.6.4.8 Major reasons for dysfunctional of irrigation cooperatives

The R value (0.97) was significant and the average RBQ value for each challenge was used and results are presented in table 4.19. The results showed that the type of management was ranked as the main reason for poor performance of smallholder irrigation cooperatives in Zimbabwe. This shows that type of management is very important in the performance of the irrigation cooperatives. Lack capital resources and water availability were ranked second and third respectively. The results are consistent with the results of the research conducted by Jimoh (2011) which showed that the most serious problems faced by agricultural cooperatives are inadequate capital accumulation, government interference and unavailability of loan. Other factors such as farmer participation at formation stage, cooperative member cohesion and hostile community were found to averagely cause poor performance of irrigation cooperatives. Among all the possible reasons production and marketing problems, education and extension and economic and social conflict got least concerns.

The reason for perceiving type of management as the most important issue could be that management is capable of being the source or perpetuating problems such as internal free rider, influence costs, and principal-agent problems. This can be evidenced from government managed cooperatives since their members complained much compared to farmer managed irrigation cooperatives. The farmer managed cooperative members felt that the cooperative belonged to them whereas all members from government managed irrigation cooperatives felt as the cooperatives belonged to the government. The reason could be that government managed irrigation cooperative members were not consulted by local authorities on who and when to resettle new farmers on abandoned plots and management committee had no right as to who join the project. This violates one of the conditions proposed for better performance of cooperatives by Prakash (2000) which states that cooperatives would function well with least government intervention and should be non-political and self-reliant organisations. This causes farmers to have no sense of ownership and they are not worried about efficient utilisation of resources. In this way, the cooperatives can be obviously plunged into serious mismanagement under the weight of State and ruling political party.

Free-rider problem referred to as a type of common property problem that emerges when property rights are not tradeable or are not sufficiently well defined and enforced to ensure that individuals bear the full cost of their actions or receive the full benefits they create Cook

(1995). The internal free-rider problem arises since the rights to residual claims in some cooperative are linked to patronage instead of investment, that is new members receive the same patronage and residual rights as existing members although the new members are not required to make up-front investments proportionate to their use.

According to Cook (1995) principal-agent problems arise because the objectives of the agent are usually not the same as those of the principal, and thus the agent may not always best represent the interests of the principal. The government as representative of the cooperative members might not be representing the needs of farmers but use cooperatives for political ends that result in influence costs. Royer (1999) defined influence costs as those costs associated with activities in which members or groups within an organisation engage in an attempt to influence the decisions that affect the distribution of wealth or other benefits within an organisation. Cook (1995) argues that in a cooperative involved in a wide range of activities, diverse objectives among its members can result in costly influence activities. These costs can include both the direct costs of influence activities and the costs of poor decisions in terms of misallocation of resources. The size of influence costs depends on the existence of a central authority with the ability to influence the distribution of costs and benefits to members, procedures that dictate decision making and degree of homogeneity or conflict among members (Cook, 1995). This could be one of the characteristics of government managed irrigation cooperative as cooperative members indicated that were not consulted by local authorities on whom and when to resettle new farmers on abandoned plots and management committee had no right as to who joined the project and his/her joining fee. In the government run cooperatives farmers showed diverse objectives as some tried to pursue hidden agenda such as political goals. As indicated by the farmers the government managed cooperatives, often experienced electricity cuts because of failure by government to pay the electricity bills in time. The pumps break down frequently and the government takes time to repair them. Thus, there was contradiction between principles of government managed irrigation cooperatives and the three fundamental principles of a cooperative business as given by Eversull (2010) which are as follows: user-owner (the people who own and finance), the business are those who use it and user-control (the people who control the business are those who use it) and user-benefits (the cooperative's sole purpose is to provide and distribute benefits on the basis of use).

The reason for ranking lack of capital resource second could be that cooperative members were poor, often subsistence farmers. They could not manage to make meaningful contribution. Low capital associated with high operating costs, low margins relatively low turnovers, narrow stock inventories are exposure to the consequence of high credit risk. The resource availability has to be adequate to achievement of the objectives. The respondents indicated that secure water supply is important for the attainment of higher cropping intensities this could be the reason for ranking it third. Farmers from all irrigation cooperatives indicated that they were affected by water shortages in summer before rain season and could not attain the intended cropping intensity.

The reason for ranking participation of farmers during planning fourth could be that involvement of farmers during planning caused them to feel that the cooperative belong to them and as such they invested heavily in them as indicated by farmer managed cooperatives. Irrigation cooperatives which were planned by the government without employing participatory rural appraisal farmers felt that irrigation cooperative belonged to the government and not to the farmers. This created a disincentive for existing members to invest in their cooperative because the government dictated decision which would cost cooperative members.

In cooperatives where members were considered to be the final decision makers, the conflicts were minimal compared to cooperatives where leaders were the ultimate decision makers. Network of relationships existing between members of the cooperative and its management is critical for the success of the irrigation cooperative. Farmers accused each other of being lazy and did not want to cooperate. This social problem is affecting the performance of the irrigation cooperatives negatively.

Interestingly, among all given possible reasons production and marketing problems were not ranked important as farmers felt that production and marketing problems were signs of poor management and lack of capital. However, farmers indicated that production problems emanated from the type of irrigation technology, whether sprinkler or surface, affects the labour inputs for the farmers and imported capital also affects production operations. It appeared that sprinkler require less labour, while surface systems are relatively more labour intensive. Farmers on the surface irrigation cooperatives complained of the high labour

demands of the irrigation leaving very little time for other important activities like weeding, spraying and organising marketing of produce. Irrigation cooperatives that have imported capital items have problems in acquiring spare parts and hence their performances were affected negatively. Spare parts for the pump are scarce and difficult to source and as a result, when the pump breaks down it takes time to repair it thus affecting the performance of the irrigation cooperative.

Lack of transport to the markets seemed to be a problem for several irrigation cooperatives since it was cited as a major drawback in marketing although given least concern by farmers. According to the farmers, transport was too expensive. The costs charged by transporters were depending largely on the condition of the roads, for example, for poor roads charges were very high according to respondents. Some farmers complained that transporters were shunning their cooperative because their feeder road was in a bad state. Those transporters who accepted to carry the produce charge exorbitant prices (US$ 0.18 per kg where under normal circumstances it was US$0.1). Farmers revealed that the enforcement of the legal system might be too weak due to conflict between economic and social purpose. For example expulsion of a member who doesn't behave is difficult because of social set-up and political reasons.

Regarding to agricultural training, education and extension the results are inconsistent with a research conducted by FAO (2012) which indicated that smallholder farmers are seriously affected by poor extension service. The reason could be that the government of Zimbabwe increased the number of agricultural colleges and vocational training centres located in all the provinces of Zimbabwe, six of which offer diplomas in agriculture. In addition to these agricultural colleges, government increased Agritex (agricultural extension officers) in all provinces, which are the link between the government and local farmers, providing technical expertise and support. About 80 per cent of farmer groups who participated as respondents in the survey commend the government on extension services indicating that, despite the fact that extension officers were operating in an environment of limited resources, the department was striving to meet its goals in the delivery of services. This has enhanced the creation of information and dissemination on technical knowhow resulting in high quality. However, other respondents (20 %) showed that the extension officers in the field lack information on markets and modern technological systems, yet these have become pre-requisites for

successful modern agriculture. Reasons cited were that most government extension officers had no access to communication technologies such as computers and were therefore lagging behind times making them outdated.

Table 4.19: Constraints faced by cooperative members

Challenges	RBQ of farmers	RBQ of Key informants	Average	Ranking
Hostile community	33.7	40.7	37.2	6
Training, education & extension	31.5	29.6	30.6	8
Production & marketing problems	37.4	35.2	36.3	7
Cooperative member cohesion	48.2	57.4	52.8	5
Farmer participation at formation stage	67.4	59.3	63.3	4
Lack of capital resources	78.5	85.2	81.9	2
Water availability	77.8	75.9	76.6	3
Type of management	92.2	92.6	92.4	1
Economic and social conflict	33.3	24.1	28.7	9

Source: Survey data

4.6.4.9 Impact of cooperatives on market accessibility

The cooperative member coefficient is statistically significant at 5 per cent level (Table 4.9). The Exp (ß) value associated with cooperative member is 4.116, which means that the odds of participation in formal market for primary irrigation cooperative member were 4.116 times higher than for non-cooperative members. An increase of one unit in cooperative membership is associated with 312 per cent increase in odds of participation in formal markets. If the primary cooperatives join to form secondary cooperative, the cooperative farmers' odds ratio become 16.941. This means that the odds of participating in formal markets for secondary cooperative member are 16.941 times larger than that of primary cooperative members. The Exp (ß) ratio for non-cooperative member is 0.243, which means if the farmer withdraws his cooperative membership, the famer becomes less times not likely to participate in the formal markets.

Predicted probabilities of cooperative membership are presented in table 4.20. The probability that the cooperative member will participate in formal markets is 0.424. This probability is higher than the probability possessed by non cooperative members. Given the condition that the primary cooperative joins secondary cooperative the chances of the primary cooperative members to participating in formal markets increase from 0.424 to 0.781. The cooperative member's chances increases by 36 per cent, which is a big percentage.

The likelihood ratio confidence interval at 95 per cent for the odds ratios are 1.013 to 2.755. The confidence interval gives a study the ability of testing the null hypothesis that the odds ratio is 1 for a significance level of 0.05. If the confidence interval does not include 1, study rejects that the two groups are not different and concludes that the odds for the two groups are different. Since the entire interval is above (11.013 to 27.55), means that the odds for the cooperative members and non-cooperative members are different. This also means that there is positive association between being a cooperative member and participation in formal food markets. This indicates that when exposed to risk factor the agriculture cooperative member farmer is more likely to participate in formal markets than no-cooperative member.

The reason attributed to the results of cooperatives could be that most small-scale producers who are contracted to wholesalers/processors in the country work in groups between 20 and 50 members, where each group has a committee structure. Supermarkets deals directly with the committee rather than with each individual farmer within the club. Producers typically crop one half a hectare of land under contract. The irrigation cooperatives are crucial not only at production stage, but also at marketing stage for example buying agricultural inputs like fertiliser, negotiating crop prices with buyers as it allows them to buy in bulk. Supermarkets make an agreement with the committee to buy produce from the farmers provided it meets the quality standards laid down. This also could be attributed to Public Sector Investment Programme (PSIP) that was introduced by the government. PSIP was a source of funding that was exclusive to smallholder farmers and importantly, no collateral was required. The farmers needed a letter of support from Agritex. Preference was given to farmers who organized themselves into cooperatives. The cooperatives that could access credit had the capacity to invest in irrigation system that could support tomato production all year round and technologies enable them to produce during unfavourable seasons such as winter.

Table 4.20: Impact of cooperative membership on market accessibility

	Non-cooperative	Primary cooperative member	Secondary cooperative
	0.23	0.424	-
Probability	0.10	-	0.781

Source: Survey data, 2013

Given the condition that the farmer was cooperative member, accessed credit ($600) from the government and owned green house (size 200m^2) his/ her probability of participating in formal markets was 0.984. In other words, his chance of supplying supermarkets or wholesalers/processors was 98.4 per cent. This proves that a combination of institutional innovations can improve farmer participation in markets.

4.6.5 Level 4 Resource allocation and Performance

Table 4.21 shows the results of the DEA and Two-stage supply chain model. This showed that the local market (directing marketing) is the least efficient market, followed by the municipal market and supermarket chain in both production and marketing. Farmers participating in chain 4, which included wholesale/processor, was found to be efficient at production stage and had the highest efficiency score at marketing sage among the four co-exist chains. Farmers who participated in chain 1, which went via local market (direct sales) was the least efficient while sale to hawkers at the municipal market and at the supermarket chain had nearly the same efficient level. Comparing production and marketing efficiency, two-stage value chain model inferred tomato producers under the study doing much better for the production than marketing. The farmers who supplied chain 1, 2, 3 and 4 could possibly reduce the consumption of inputs at marketing stage by 47 per cent, 33 per cent, 14 per cent and 3 per cent respectively without reducing output level. At production stage, only farmers from three chains namely chain 1, 2 and 3 were supposed to reduce input consumption by 27 per cent, 12 per cent and 11 per cent. This indicates the opportunities to improve their profits lie in the marketing perspectives rather than production. The higher market price cannot compensate the value loss incurred by the high level of transaction costs. This means that the tomato producers should participate in supply chains that have low transaction cost rather than ask for a higher market price. The results confirm the findings of Ruben (2006) that vegetable supply chains in Nanjing area are less efficiency in general.

Table 4.21: Technical efficiency scores of production and marketing stages

Marketing channel	Production TE	Marketing stage TE
Chain 1	0.75	0.53
Chain 2	0.88	0.67
Chain 3	0.89	0.76
Chain 4	1	0.97
Average	0.88	0.73

Source: Survey data, 2013

4.6.5.1 Land use efficiency

The land use efficiency of a farm with respect to any particular crop enterprise can be expressed in terms of percentage as compared with average yield expected by the government. Table 4.8.7 shows land use efficiency scores with respect to market channel. Since land use efficiencies for all market chains are less than 100 per cent means that the farmers can improve in terms of land utilisation, it implies that all farmers under study were not fully utilising land as per government expectations. If farmers increase land use efficiency there is room for them to increase their incomes. This shows that the land is not fully utilised. The results are consistent with the research conducted by FAO (2012) which showed that farmers fail to maintain consistency in terms of quality and quantity because of lack of modern production technology.

Table 4.22: Land use efficiency performance

Market channel	**Land use efficiency**
Chain 1	0.59
Chain 2	0.72
Chain 3	0.76
Chain 4	0.94

Source: Survey data, 2013

4.6.5.2 Financial performance

Returns on investment (ROI) enables farmers to know how much do they get per every dollar invested in production and marketing. A higher ROI means that investment gains compare favourably to investment costs.

Table 4.23: Financial performance

Marketing channel	Returns on Investment
Chain 1	0.38
Chain 2	0.43
Chain 3	0.49
Chain 4	0.57

Source: Survey data, 2013

The rate of revenues received by the farmers for every dollar invested in the production and marketing by the farmers selling to processors is higher than revenue received by farmers producing selling either to supermarkets, hawkers or local market (Table 4.23). The farmers realise 0.4, 0.43, 0.49 and 0.57 dollar return for every dollar invested by farmers connected to local market, hawkers, supermarkets and processors respectively. This implies that selling to processors has higher level of investment efficiency than selling to supermarkets, hawkers and local market by 8 per cent, 14 per cent and 19 per cent respectively. Generally, the level of ROI realised by the farmers selling to supermarkets, hawkers and local market is below 50 per cent, which means that investment gains compare unfavourably to investment costs.

4.6.6 Constraint and Issues Identified

The production and marketing problems commonly faced by respondents were presented below and some are summarised in table 4.24.

4.6.6.1 Limited Access to Water by Farmers

Access to water is by far the commonly constraint facing small farmers wishing to go into advanced stages of commerciation. Wherever there is water, as on the farm under investigations in many parts of the study area, farmers have many production cycles per year compared to other farmers in surrounding facing water challenges. Agritex admits to lengthy delays in completing on-farm irrigation canal systems due to bureaucratic delays, poor

coordination of deliveries of cement and other materials, no budget for vehicles and other reasons. In some cases, dams have been under construction for a long period. Another problem which affects irrigation cooperatives was siltation of the river necessitating drilling of deeper wells to reach the water level. Lack of funds has delayed this work, which is relatively simple and inexpensive (about US$5,000).

The overall potential of the sector is subdued due to the fact that Zimbabwe lacks an overall national irrigation strategy. Irrigation plans have largely benefited the large-scale commercial sector. Within the smallholder sector, benefits have been unequal. While some well-resourced individuals and co-operative farmers have gained access to irrigation facilities, the majority of small-scale farmers continue to use the bucket and the furrow system, which is very tedious and inefficient, especially on larger plots. Small-scale farmers are generally far from main water supplies, which make the construction and maintenance of irrigation schemes costly.

4.6.6.2 Problems faced in contract farming

In some cases contracts lack transparency. However, supermarkets point out that while the contracts may lack transparency the major problems relate to farmers who join schemes with high expectations, without the full knowledge of the system. On the other hand, it is common practice particularly among supermarkets and processors to downgrade the produce to justify paying farmers lower prices. Payments are also tardy, straining farmers' cash flow. Many contract farmers feel that they are being short changed as the prices which middle players subsequently receive are much higher than that paid to farmers.

Furthermore, contractual arrangements may have a lot of hidden costs. Many supermarkets do not have binding contracts and can renege on their obligations. Smallholders are unable to seek recourse for such actions since smallholder farmers lack evidence of the contract being made as contracts are informal arrangements and due to their lack of knowledge of the legal system. Supermarkets may not wish to bind themselves to written contracts in case farmers fail to meet the standards laid down. However, if upon harvesting, the company fails to purchase the crop, this leaves farmers stranded without a market for their produce. Contractors either renege on the agreement since some of the contractual agreements are not binding and/ or farmers fail to meet some requirements. In case of sub-contacts, middlemen

have also cheated farmers by not paying them after the delivery of the produce. Middlemen also negotiate higher prices with processor organisations and lower prices with farmers. In the end, middlemen benefit at the expense of the small-scale producer. Unscrupulous middlemen are also a problem. Informal municipal market is associated with the theft of the produce and cash especially on busy days; many farmers have incurred heavy losses due to such problems.

4.6.5.3 Poor road infrastructure

A further constraint that many farmers face and one that is often beyond their control relates to the transportation of commodities from the farm to the market. Poor infrastructure and inadequate transport channels pose great problems for smallholder farmers who lack their own means of transport. An example of this is taken from the farmers end up participating in chain 1 (local markets) because of transport problems or some crops rotting in fields due to inaccessible roads during the rainy season.

Respondents point out that poor transport increases marketing costs substantially. The use of buses for example to transport produce to market presents hidden costs; buses seldom go directly to markets. In some cases transport fees charged exceeded the value of produce. As majority of farmers have no option but go to municipal markets where they must try to sell their produce within one day, as an additional day would mean stand and storage fees, and food and accommodation expenses.

Infrastructure however, not only relates to transport systems communication systems. A viable communication system is necessary if farmers are to receive up-to-date price information for example. This is important due to daily fluctuation of prices and the fact that many smallholders are scattered across rural settlements with low road densities.

4.6.5.4 Lack of market information/ Lack of market price information

There are no reports of market prices are made public on a daily basis. Although farmers were familiar with the particular standards required by the market, the daily market price and quantity of produce may prove problematic. This may be related to poor infrastructure as highlighted above. Regardless that smallholders have unlimited access to phones and radios, few listen to the price information broadcasts on the radio for example, because they are

unaware of the broadcast time as they are rarely broadcast. In addition some information is outdated. Many farmers rely on information received through friend, friends who have limited information and outdated. The information that farmers currently receive is often too technical and furthermore it is seldom received on time. It is essential that farmers become more informed about market openings through improved market intelligence.

4.6.5.5 Lack of farmer initiative and heavy reliance on donors

Many organisations and institutions working with small-scale farmers and trying to form linkages with them lamented the absence of long term planning on the part of farmers. Some noted the heavy reliance on donor initiatives (NGOs for example). Most organisations that promoted small-scale farmers felt that farmers do not normally take the initiative to get involved in new adventures without extension assistance and supervision. Where there are no or few donors, not much activity takes place regardless of the fact that farmers may have access to productive soils and dams to provide irrigation water. All in all there are various factors (such as literacy rates, access to information and cultural norms among others) that may influence a farmer's willingness to participate in new activities or marketing arrangements (World Bank, 2001).

Table 4.24: Gaps and Issues Identified

Gaps	Issues
Lack of market information	Refers to current price and quantity demanded
Water availability	Seasonal in most cases
Institutional responsibility	AGRITEX responsible for production and marketing activities has no resources Some AGRITEX personnel need horticultural training
Labour	Lack of because household members or hired labour is not available
Inputs	Fertilisers not always available in the market
Processing	No value addition at all
Land rights	Not able to use land as collateral
Contracts	Hidden costs

Source: Study survey, 2013

4.7 Viable supply chain

The supply chain that includes wholesalers/processors was observed as most viable in terms of efficiency followed by the chain that goes via supermarkets, hawkers and lastly the chain involves direct marketing. However, the chain that involves wholesalers/processors is the last in terms of quantity supplied showing that it is not accessible. Therefore, effort should focus on improving the municipal markets as they handle the largest volume of tomatoes from smallholder farmers.

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

Government of Zimbabwe identified rural development as one of its top priorities and placed agriculture at the centre of its strategy as a result of land reform program that ended in 2006. Approximately 75 per cent of arable land is in the hands of smallholder farmers. Therefore, linking smallholder farmers with markets has been identified as one of the major issues in policy and practice in improving livelihoods for millions of poor in the country.

Over the last decade Zimbabwe' smallholder horticultural production expanded with vegetable sector taking a lead. Tomato is among the most important vegetables grown by smallholder farmers as food and cash crop in the country. Tomato is mainly used for hawking by small-scale entrepreneurs in the informal sector of Zimbabwe. Thus, it was selected for study. It is estimated that tomato small scale sector produces about 60 per cent of all locally marketed tomato and the rest comes from the large commercial sector. The objectives of the research were to identify the tomato supply chains, analyse the price behaviour of tomato, assess the economic performance of the major supply chains, evaluate the institutional innovations in the supply chains and suggest viable supply chain options for smallholder tomato farmers in Zimbabwe.

The study was based on both primary and secondary data. Primary data were collected by means of formal interviews and structured questionnaire from farmers, market-intermediaries and government officials. Mashonaland East was purposively selected because of high tomato production in the province. Multi-stage random sampling technique was adopted for sample selection. The sampling frame was provided by Ministry of Agriculture. The three districts were randomly chosen for the study namely Hwedza, Goromonzi, and Mutoko. A sample of 120 farmers was selected. In addition, the samples of 10 wholesalers, 10 processors, 10 big supermarkets, 10 small retailers and 10 officials from the Ministry of Lands, Agriculture and Rural Development were selected.

The average weekly and monthly nominal price data spanning from January 2008 to August-2013 were obtained from Agritex, Zimbabwe Farmers Union and Agricultural Marketing Authority. Six municipal tomato fresh markets were identified as they represented major

outlets of tomatoes in the country namely Gweru, Chiredzi, Mbare, Mutare, Masvingo, Chiredzi and Bulawayo.

Descriptive analysis was employed to provide a snap shot of the situation under study, which consists of household level information. A descriptive statistics such as average, ranges, median, standard deviation, t-test and chi-square test were used. Random Utility Model was used to determine socio-economic factors influencing participation of smallholder farmers in either formal market or informal market.

Price behaviour was studied under price seasonality and spatial market efficiency. The price behaviour was studied using the techniques of classical time series. Ratio to moving average technique was employed to compute price seasonal indices. The study tested whether the assumed time series were stationary, which is a necessary condition for the further testing procedure. The study employed the Augmented Dickey-Fuller test for stationarity. After using Johansen cointegration analysis, the study concluded long run co-integration among spatial markets and the study estimated the vector error-correction model.

The Value Chain Mapping was done to identify the actors. The study adopted the Institutional Analysis and Development (IAD) conceptual framework to assess the nature of relationships among supply chain actors. Transaction Cost Economics approach was used to determine types of institutions which were needed (whether formal or informal) in this context to improve smallholder farmer access to high value markets. The study employed Data envelopment analysis to evaluate economic performance of supply chains and allocation of resources. Return of Investment was computed to assess performance.

The study identified four supply chains, which were common in the area of study. The first chain involves direct marketing, operating through the informal sector where farmers were selling to boarding schools, mission hospitals, villagers and passers-by. Second chain, tomatoes were passing through municipal markets which were dominated by hawkers. The third supply chain, produce passed through the supermarket targeting the medium and high class urban residents. The fourth chain was characterised by the wholesalers and processors that fed into supermarkets and other small shops. Chain 1 and 2 and chain 3 and 4 constituted informal and formal markets respectively.

Volume mapping results indicated that a total of 814.2 tonnes of tomatoes were produced in Mashonaland East province under the period of study (2012/13 season) by respondents. Chain 2, which was passing through the informal sector and included hawkers (urban markets), was handling the largest volume of tomatoes (409.4 tonnes) in one production cycle in 2013 season. The second biggest chain involved supermarkets in the formal market handling 321.4 tons. The informal supply chain which ends in the local market comes third with 43.7 tons and lastly the forth chain, which included processors/wholesalers was handling 39.4 tons.

The price index at its peak point was found to be 1.367 in July, meaning that prices are generally 37 per cent higher than the annual average price. In contrast, the price index at its lowest point was found to be 0.717 and 0.718 in January and November respectively, meaning that prices are 28 per cent below the annual average price. The seasonal price index pinnacle tends to occur between May and July, the period characterised by low temperatures and sometimes frost creating unfavourable production conditions as tomatoes are cold sensitive, so may be affected by frosts.

The results of λtrace connote that the rank of Π could go up to 3 at 95 per cent level of significance. This showed that there were at least three co-integrating equations in the estimation. The tomato markets were stationary in three directions and non-stationary in three directions since the trace statistics indicated that there were three co-integrating vectors and three common trends. This indicated that the tomato markets in six major regions during the study period were fairly linked together and that therefore the long-run equilibrium was stable. The results for causality tests indicated that price changes in six municipal markets were complex as they were to be set around more than one market. Thus there was no centre market among six markets although Mbare was perceived as dominant fresh tomato market.

The short-run dynamics results from the vector error correlation model revealed that all the estimated short run coefficients except for four were statistically insignificant at the 5 per cent level. The coefficients' values range between 0.013 and 0.55. This suggests that the transmission of price changes from one market to another during the same week was weak. The adjustment toward the long run is slow in the case of price changes in Masvingo, Gweru, Mutare, and Chiredzi at 0.7 per cent, 5 per cent and 22 per cent respectively. However, only

Masvingo at 36 per cent showed faster transmission and Chiredzi at 48 per cent showed faster adjustment.

Data envelopment analysis results indicated that the chain that includes wholesalers and processors was the only efficient chain when constant return to scale is assumed. Supermarket chain was efficient when variable return to scale was assumed. Chain 1 and 2, which included passers-by and hawkers were inefficient under both constant return to scale and variable return to scale technologies assumptions. It was observed that chain 1and 2 were on the increasing returns to scale while chain 3 was on decreasing returns to scale. Chain 1, 2 and 3 were operating at sub-optimal scale level (scale inefficiency).

The score reliability estimates were high, ranging from 0.72 to 0.94; all were greater than Streiner's general rule of thumb for reliability (0.7). Supermarkets trust to farmers by 0.7, farmers to supermarkets trusts by the value 0.6. This means that farmers had some trust in supermarkets while supermarkets had high trust in farmers; the exchange was therefore almost reciprocated. The exchange between farmers and other chain players such as hawkers and processors was not reciprocal.

Credit was significant at 5 per cent level. The odds ratio for credit were 12.32 meaning that that the odds of participation in formal markets for smallholder farmers who had accessed credit were 12.32 times greater than the odds for the smallholder farmer who could not access credit. Greenhouse was statistically significant at 1 per cent significance level with the significance values of .002. The cooperative membership coefficient was statistically significant at 5 per cent level. The Exp (ß) value associated with primary cooperative membership was 4.116, meaning that the odds of participation in formal market were 4.116 times higher for cooperative members than for non-cooperative members.

Two-stage supply chain model showed that farmers who participated in chain 1 (directing marketing) were the least efficient, followed by the chain 2 and 3 at both production and marketing stages. Chain 4 was efficient at production stage and had the highest market efficiency level among the four co-exist chains. Thus, chain 4 that included wholesalers/processors was observed as most viable in terms of efficiency. However, chain 4 was the last in terms of quantity supplied showing that it was not accessible. Therefore, effort

should focus on improving the municipal markets as they handled the largest volume of tomatoes from smallholder farmers.

5.1 Conclusion

The study concluded that Chain 2, which included hawkers, was handling the largest volume of tomatoes. Chain 4, which includes processors, proved to be production and scale efficient.

The price changes in six municipal markets were complex as they were to be set around more than one market. There was no centre market whose price changes influenced all other markets. The transmission of price changes from one market to another in the short run was weak. Thus, spatial markets were not efficient in the short run although showing stable equilibrium in the long run

Irrigation cooperatives as institutional innovations performed badly due mainly to type of management, lack of capital resources and poor farmer participation at formation stage. It appeared that many of these irrigation cooperatives were performing badly because they didn't adapt a user-owner, user-control and use-benefit business model. The cooperatives plunged into serious mismanagement under the weight of government bureaucracy. Without transparently electing leaders of cooperatives, farmers are not truly empowered to demand the goods and services which they need in order to boost productivity and earn better incomes. Without a demand-driven or service-oriented approach, cooperative leaders do not have the incentive to reach out and bring the needed technology, information and services to their members. Therefore, the irrigation cooperatives are not failing farmers but how they are implemented is a big question in Zimbabwe.

The existing land tenure doesn't allow farmers to use land as fixed capital. Thus, present land tenure arrangement does not provide much room and incentive for farmers to expand their holdings.

The study also concluded that producers under the study were doing much better at production than marketing stage. This indicates the opportunities to improve their profits lie in the marketing perspectives rather than production for tomato producers under study.

There is room for smallholder farmers to reduce input consumption without necessarily changing level of output. The higher market price cannot compensate the value loss incurred by the high level of transaction costs.

5.2 Recommendations

Based on the findings that were made in this thesis, a number of recommendations were made. A number of the stumbling blocks that contribute to the exclusion of smallholder farmers from participating in formal markets relates to the absence of an enabling environment.

Since farmers can gain better income by reducing consumption of inputs without necessarily asking for high prices, they should pursue the low transaction cost marketing chains rather than ask for a high market price.

Municipal markets continue to rise in popularity as consumer demand for obtaining fresh products directly from the farm increases; as a result, farmers' markets have become an increasing visible part in the urban-farm linkage. However, municipal markets are characterised by poor market infrastructure and unfair trading systems by middlemen and transaction costs which constitute major drawback to better income. Thus municipal markets should be given due attention by the government. The government should intervene and shorten the chain by eliminating fly-by night traders in informal supply chain and support transporters to improve transport services to farmers.

Strengthening the tenure security of smallholder farmers would provide a strong incentive for farm improvements and a more effective use of local land resources. Thus land tenure security can induce institutional innovations. Insecure tenure limits farmer incentives to make long-term development investments on their farms. The inability to offer land as collateral for obtaining credit is another disadvantage. The present users of the land are not true owners, since they cannot sell the land if they wish to do so. Thus government is recommended to put in place some policies that facilitate the transfer of secure tenure to smallholder farmers who operate on communal and resettled farms. Secure tenure contributes to an enabling environment. Since the government is worried with a tenure document which would reverse

the land reform programme if the farmer fails to pay off the loan as the land is sold off to people who have money, the government should consult banks and other stakeholders to come up with a lease documents acceptable to all parties without leading to the reversal of the land reform programme.

Without sound technical and financial backing, any good policy or legislation will prove difficult to implement. Also the introduction of conflicting policies has proved to be detrimental and retrogressive, as evidenced by the land reform process, which despite possible good intentions has created greater confusion in water management circles. Political influence should always be kept at minimum levels. Such setbacks imply that it would take much longer to realize set targets within the water sector. Greater emphasis be placed on water development and that support institutions should work together and prioritise the provision of hardware requirements of gardens, invest in water harvesting and extraction technologies such as small dams construction, borehole drilling and sand abstraction, and to adopt a livelihoods (holistic) approach to support programmes. Given the water shortage constraints faced by most communities, drip kits can offer great promise.

A viable communication system is necessary if farmers are to receive up-to-date market and price information for example. Arrangements should be made for an Agritex worker, with knowledge of horticultural marketing, to visit each market early every morning. After visiting the market the officers should fax a simple report to the Agritex head office in Harare. On receipt of these reports the Agritex head office will put together a consolidated report each day and make it available to interested growers. If possible the daily reports should be available by 9 a.m each morning. The report should be sent to the media (TV, newspapers and radio stations) free of charge and they should be encouraged to publish it. Copies could also be faxed to interested agencies such as Agritex area offices and they should find ways to make the information available to growers in their regions. Experience in other countries has shown that many businesses where growers congregate (e.g. markets, input suppliers, bars etc.) are keen to display market bulletins on their notice boards if they are sent to them. Another way in which the daily reports could be made available to growers is via a recorded message which they can access by telephone. More complex electronic methods of distribution could be considered in the future in the light of demand and the funds available. Information that is up to date of this type will help farmers plan their daily marketing and

improve their negotiating position with buyers who call at their farms to purchase goods for re-sale in the urban areas.

The information that farmers currently receive is often too technical. It is essential that farmers become more informed about market through improved market intelligence.

The weakly market price of produce in the short-run proves to be problematic since rate of transmission was weak. This may also be related to poor market infrastructure. The government should promote farm mechanization and market infrastructure development programs.

There is a marked lack of value addition and agricultural-centred manufacturing to tap into the primary industry. Most farmers have mustered the production of quality tomatoes but still no one had considered building a processing plant in the area. Farmers should invest in more advanced drying methods such as the use of artificial dryers. Artificial drying requires greater capital investment, as production costs are higher owing to costs on fuel, equipment, spares and maintenance. Furthermore the skills needed to maintain such equipment may not be available locally. Mechanised techniques are usually more applicable for use in urban and peri-urban areas due to better access to fuel. However, artificial dryers enjoy independence from weather conditions, ensure a greater degree of control over the drying process, have a greater drying capacity.

It is recommended that the government should commission the preparation of relevant guidelines/manuals/pamphlets that could be translated into the main dialects for distribution to farmers. Agritex in consultation with other stakeholders and with adequate resources should be the leading player in preparation and distribution of the materials. In terms of extension, it is paramount that Agritex staff that are non-horticulturist be trained to improve their capacity to support farmers. The use of proven extension techniques of on-farm methods and result demonstrations can be employed. Lead/contact farmers can be used as focal points for these demonstrations. These could be used in the context of Farmer Field Schools, Junior Farmer Field Schools, Associations, or other mechanisms that bring people of common interest and goals together. The extension should not just focus on production only but also marketing which is a paramount problem among famers.

Policies required are that incentivise commercial loan providers to develop financing products that are tailor made for smallholder farmers. The very nature of being smallholder farmer normally excludes smallholder farmers from having access to commercial loans. Access to loan will allow smallholder farmers to supplement their cash flow and hence to overcome a major stumbling block that contributes to the poor production during winter period.

Irrigation cooperatives performed badly or did not survive due mainly to type of management, lack of capital resources and poor farmer participation at formation stage. It appears that many of these irrigation cooperatives were performing badly because they didn't adapt a user-owner, user-control and use-benefit business model. The farmer managed irrigation cooperatives were better managed than government managed irrigation cooperative. The government should not directly influence management of the irrigation cooperatives. Participatory rural appraisal should be adopted during planning stage of cooperatives as a methodology that can enhance the feeling of a great degree of ownership and responsibility in the rural poor for better results and social acceptance of the programme. The savings group should also be upgraded to self help groups so that they can be able to access loans from commercial banks.

5.3 Recommendations for further study

Research is needed to assess the prospects of transforming communal tenure and permits into individual tenure/freehold system (title deeds).

The potential of transitioning from communal farmers to individual farmers through the establishment of efficient land rental markets for emerging farmers also needs to be investigated. Given the challenge associated with the transfer of title deeds to individual farmers there may be scope for a rental market to secure tenure for individual farmers in the transition period. The rental market may even be sufficiently viable to decrease the need for transferring the title to all individual farmers.

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APPENDIX 1

APPENDIX-1

Irrigable land size and water availability and access

The average irrigable land size under tomato production for respondents who participated in chain 1, chain 2, chain 3 and chain 4 was 0.24, 0.37, 0.35 and 0.4 respectively. Almost all respondents indicated that to ensure successful commercial tomato production, irrigation was a critical between June and October. The respondents (87%) cited unreliable source of water and poor water drawing technology as reasons for partially participating or completely excluded from the sector at one point or another. The results showed that smallholder farmers were drawing water from one or more of the following sources:

i) Open shallow and deep wells

ii) Dams

ii) Boreholes

Although respondents indicated that they were not relying on one source of water, about 86 per cent and 83 per cent of the farmers who participated in chain 1, chain 2 respectively were mainly getting water from open shallows and deep wells. In contrast to farmers who participated in chain 1 and 2, farmers who participated in chain 3 (75%) and chin 4 (69 %) were getting bulk of their water from dams. The respondents experienced water shortages in September and October before receiving first rains, making it difficult to attain the intended cropping intensity as most of the water sources (especially shallow wells) dried up. Farmers who enjoy close proximity to irrigation sources or who have adequate water supplies during the dry season have greater potential to produce for the market throughout the year. In some cases boreholes were broken down and communities found it expensive or difficult to repair, resulting in crop failure. It was noted during the study, that water related issues were invariably high among respondents, if not at the top, of respondents' priorities. The total amount of water available, the often conflicting uses of water and the seasonality of supply are therefore important considerations in planning and implementation of irrigation support activities.

Water Lifting and Delivery Technologies

Several technologies were reportedly used to lift and deliver to fields and these include the following in order of frequency of use:

i) **Buckets**

Buckets were the most commonly used technology to lift water from shallow or deep wells and transfer from boreholes. From deep wells the bucket was used with a rope. The use of the buckets for irrigation was reportedly easy and faster although the labour input was higher and water use less efficient.

ii) Siphons

These were common to those who irrigated from dams and channelled water through canals. Some farmers especially those irrigating from shallow wells also used siphons. Siphons were reported to be simple and released labour to do other things because management requirements were low, although soil displacement at the point of discharge could be a cause for concern. The cost of the pipes under the prevailing macroeconomic environment affected profitability.

iii) Pumps (Treadle, Elephant) and electrical pumps

The use of treadle pumps was reportedly on the increase among respondents. Although they had a high initial capital requirement the benefits reportedly outweighed the cost. They were reported to save labour especially where they were used to pump into reservoirs, which facilitated irrigation scheduling. They were used to relieve labour requirements in loading drip tanks. Elephant pumps were based on rope and washer technology, and provided an even simpler version of water lifting technology than the treadle pump because they were hand driven in a rotary motion as opposed to leg powered high step motion. Both pumps were manufactured locally and required simple maintenance. Frequent electricity power cuts were disrupting irrigation, eventually reducing output.

iv) Taps and Hoses

These were common in peri-urban areas where there was piped water. Their use was depending on the seasonal rainfall and water availability. If water availability was poor, use of hoses was banned. Use was also reported in rural areas where there were boreholes or dams with high head, or where sitting of constructed reservoirs allowed gravity flow to gardens.

v) Drip Kits

Use and popularity of drip kits was reportedly on the increase in communal areas. Kits distributed have normally been 100 or 200m2, although a 10m2 kit has recently been introduced for urban and backyard garden use. Respondents that received adequate training

and used the kits were reported to have experienced great improvements in crop productivity as well as income levels. Some were reported to have bought the 500m2 kits in order to increase the area under production, while others opened up other plots using the same kits. Some kits were reportedly not being used despite the envisaged advantages because farmers were reported to have received the kits without training on their use. Some did not have perennial water sources hence could not use the kits throughout the year.

The type of irrigation technology affects the labour inputs for the farmers. Farmers on the surface irrigation schemes complained of the high labour demands leaving very little time for other important activities like weeding, spraying and organizing marketing of produce. Thus, respondents' irrigation capacity was limited because watering was done by hand via buckets or treadle pumps. Family members could spend six hours a day watering half an acre in the dry seasons.

Soil erosion was cited by respondents (95%) as a serious threat to water availability. In the climatic conditions which prevail throughout most of Zimbabwe, fluvial erosion is dominant, that is the effects of rain splash and run-off, both surface and subsurface. Rates of soil formation in Zimbabwe are very slow (e.g. 400 kgs/ha/year), whereas rates of soil erosion are very much greater. The estimates for average soil losses on crop lands and grazing areas on commercial farms are 5 tonnes/ha/year and 3 tonnes/ha/year respectively. The equivalent average for communal lands is 50 and 75 tonnes/ha/year. The consequences of this erosion are seen in general declines in crop yields and very high rates of siltation of reservoirs, especially of the smaller dams used for rural water supplies. Small dams are likely to fill with sediments within 15 years of construction and even the larger irrigation schemes are being affected adversely by siltation problems (Government of Zimbabwe, 2012). Thus, soil erosion is clearly an important problem in the study area especially within the communal lands. It is essential that conservation measures be considered as a key part of development strategies in these areas rather than being treated as a token appendage.

APPENDIX 2

APPENDIX-2

Household Level Survey Questionnaire

Market access for smallholder tomato farmers in Mashonaland East Province of Zimbabwe: An economic analysis.

INTRODUCTION

Good morning/afternoon. My name is Zivenge Emmanuel, as part of my studies; I am carrying out a study on **Market access for smallholder tomato farmers in Mashonaland East Province of Zimbabwe: An economic analysis.** The purpose of this study is to determine the efficiency of supply chains accessed by smallholder farmers in Zimbabwe. This information is **confidential** and will only be used by myself to produce a report which will not make reference by name to any one farm/farmer. I will be grateful if you could assist me in filling out this questionnaire in as honest a manner as possible. This questionnaire should be completed by or on behalf of farmers who operate their own farm, work on a rented farm or on land farmed on shares.

Questionnaire identification

1) Household Number_____

2) Enumerator Name_____

3) Date of Interview Mm _____ _____ _____

4) District_____

5) Village_____

A. General Information about the farmer

1) Please indicate the ownership of the farming unit. Is this unit owned by?: (Please tick below)

Individual ☐ Family ☐ Partnership ☐ Cooperative Society ☐

Other specify ☐

2) Respondent's relationship to the farmer

.....

3) What is the type of your household? *1. Male headed. 2. Female-headed) 3.Male-Female headed 4. Child headed (youth) 5. Other (specify)*

4) What is the age of the household head/ farmer?.....

5) Education level of the household head/farmer

a) No education (NE) b) Primary school not finished (PNF) c) Primary school finished (PF) d) Secondary School not finished (SNF) e) Secondary School finished (SF)

f) College g) University (U)

7) Does the household head / farmer hold any Agricultural training? *1. Yes 2.No*

8) If yes which type of agricultural training does the household head have?

a) Crop husbandry b) Animal husbandry c) Irrigation d) Management e) Other (specify)

9) Which level of agricultural training qualification does the household head hold?.

1. *Certificate 2. Diploma 3. Degree 4.other (specify)*

10) Is the household head a full time farmer? *1. Yes 2.No*

11) What is the size of your household (permanent residents only)?.....

12) What is the main source of your household income?.....

a. Agriculture b. Salary c. Remittance d.non agric-business e. Govt grant f. Other (specify)

a. Farm income per month/per year?	
b. Non-farm income per month/per year?	
c. What is the total income that your household receive?	

13: Land tenure details

Land tenure types	Plot Area/size (ha)	If leased/share cropping What is annual fee?

Code: *a) free hold b) communal c) leased d) sharing cropping e) inherited*

14) FARM INVESTMENTS (other than land)

SN	Asset	Number	Present value
1	Cattle		
2	Goats		
3	Poultry		
4	Tractor		
5	lorry		
6	Mobile phone		
7	Wheelbarrow		
8	Scorch-cart		
9	Others (specify.....)		

WATER SOURCE AND IRRIGATION SYSTEM

15) Source of Irrigation (Give tick marks)

a) Well b) Borehole c) River d) Pump (Specify.....)

Source	Total units/ number	Year of digging/ installation	Depth (m)	Cost

c) What type of irrigation system do you use for growing your tomatoes and leaf vegetables?

1) Bucket system 2) Drip irrigation 3) hydroponics 4) flood irrigation 5) Sprinkler 5. Other (specify).....

Labour Supply

16) a) What is the source of your labour?

SN	Source	Yes/No	Percentage
1	Family labour		
2	Hired labour		
3	Permanent employees		

b) Do you hire out labour?.....

PRODUCTION AND PRODUCTION COST

Production

17) a) How do you prepare your land? (Circle all that apply)

□ Use own hoes □ Use own cattle/donkey □ Hire draft power □ Use own/hired tractor

b) When do you produce?

a) Winter b) Summer c) Throughout the year d) other specify.....

c) Fill the table below

The question refers to previous production

Area	
Production (kg/crates)	

Production cost

NB: Provide information for your previous production season

18) a) Did you purchase seedlings or raise seedlings?

a) Raise b) Buying seedlings

b) If purchase, what was unit cost (seedling) and total cost?

i) Total cost.....

c) If raise, fill table 1 below

Give the type of the seed.....retained, hybrid

Nursery

SN	Activity	Cost per unit	Total quantity	Total Cost
1	Seed			
2	Mulching			

3	Chemical Fertiliser			
a)				
b)				
c)				
d)				
4	Organic manure			
5	Pesticides/ Insecticides			
a)				
b)				
	Labour			
1	Seed bed preparation			
2	Sowing			
3	Shade for seed beds			
4	Watering			
5	Chemical application			
6	Fertiliser application			
7	Weeding			

d) **Main Land**

SN	Activity	Cost per unit	Total quantity	Total Cost
1	Chemical fertiliser			
a)				
b)				
c)	Transportation of fertiliser			
2	Organic fertiliser			
a)	Farm yard manure			
b)	Green manure			
c)	Composite manure			
3	Pesticides/Insecticides			
	Labour			
1	Land preparation			
2	Transplantation and planting			
3	Weeding			
4	Fertiliser application			
5	Pesticides application			
6	Pruning & Trellising			
7	Irrigation			
9	Harvesting			
8	Marketing			

Post harvest

19) Do you undertake any of the following post harvest handling techniques? 1-Yes or 2-No

SN	Service	Response
1	Wash produce after harvesting	
2	Grading if yes, how many grades do you have What percentage is constituted by grade A	
3	Store produce in cold room	
4	Use refrigerated transport to deliver produce	
5	Other (specify.....)	

20) a) What criteria are most important when you are grading tomato?
Rank 1 to 5, with 5= most important

SN	Variable	Ranking
1	Produce's colour	
2	Produce's size	
3	Produce's cleanliness	
4	Lack of bruises or damage from pests	
5	Other (specify.....)	

b) Please provide details of the packaging used in delivering packages

a) Plastic bag b) Sack c) Wooden crate d) Sandark crate e) Other specify.....

c) Are packing materials easily accessed?

Yes No

Source of funds

21) a) Major source of funds for production activities? 1) Yes 2) No

SN	Source	Yes/No	Percentage
1	Remittance from family members		
2	Hire out labour		
3	Borrowing from other members of the family		
4	Credit from buyers (Specify your buyer.....)		
5	Credit from Banks		
6	Grants from government		
7	Credit from the association		
8	Other (specify.....)		

b) What are the major limiting factors in accessing credit?

Please rank the factors from 1 to 5 in terms of importance (*1 = limited importance to 5 = very important*)

- High interest rates

1 2 3 4 5

- Lack of collateral

1 2 3 4 5

- High transaction costs

1 2 3 4 5

- Lack of information on credit

1 2 3 4 5

- High risk of default in my operation

1 2 3 4 5

- Small scale of my operation

1 2 3 4 5

Farmer groups

22) a) Are you operating as a part of farmer group?

◯Yes ◯No

b) If yes, answer the following questions

c) How many years have you operated as a group.....

d) What are the benefits you are getting from being a member of the group.....

.....

.....

.....

e) If no, why.....

.....

.....

f) Are you still part of that group

◯Yes ◯No

g) If no, why.....

.....

.....

23) a) Please rank from 1 to 5 the advantages of working as a farmer group as you see them

5= greatest advantage

SN	Advantages	Rank
1	Find the market	
2	Access to finance from other farmers	
3	Easy to source inputs	
4	Sharing transportation cost	
5	Assistance from extension staff	
6	Sharing information	

b)What problems have you experienced in farmer groups? Please rank 1 to 5. 1=least problem, 10 = most common problem

SN	Variable	Ranking
1	Hostile community	
2	Training, education & extension	
3	Production & marketing problems	
4	Cooperative member cohesion	
5	Farmer participation at formation stage	
6	Lack of capital resources	
7	Water availability	
8	Type of management	
9	Economic and social conflict	

Marketing

24) a) Where do you source your agro-inputs? (Percentage)

SN	Inputs	Ministry of agriculture (%)	Retail outlet (%)	Middleman (%)
1	Seed			
2	Fertiliser			
3	Pesticide			
4	Chemicals			
5	Others			

b) How do you market your products?

a) By yourself b) group c) employ seller d) selling agent

c) Who buys your products? 1-Yes, 2-No

SN	Buyer	Yes/No	Percentage (%)
1	Local consumers		
2	Hawkers		
3	Small shops		
4	Supermarkets		
5	Processors		

Transport

25) What is the distance to your market?.....

a) How do you take your product to the selling point?

Transport arrangement used	Tick√	Percentage (%)
Own transport		
Private transporters		
Public transporters		
Buyers pick it up from my farm		

Pricing

26) a) Could you describe on how you set prices with buyers?

.....
.....
.....
.....

b) What is your current selling price US$/kg.....
c) Who are the players determining prices?.....

d) Are you satisfied with the price?
1) Unfair 2) Relatively fair 3) Fair 4) Good

e) Factors governing the price Rank 1 to 5, with 5= most important

SN	Factors governing the price	Rank
1	Seasonality	
2	Production in other districts	
3	Bargaining/ negotiating strength	
4	Storage facilities	
5	Availability of processing units	
6	Road state	
7	Information on prices	
8	Information on demand	
9	Quality of produce	
10	Good relationship with buyers	
11	Limited availability of market	

Marketing Costs

27) Fill the table below

Activity	Unity cost	Total cost
Loading costs		
Transport		
Market fee		
Off-loading and displaying		
Bus fare		
Accommodation		
Food		

28) If you are in contract with the buyer show its nature.
Code of contract: 1) Contract of delivery 2) Contract covering all production of the crop grown this season 3) longer term contract to supply buyers (more than one season)

29) How well are you informed on the following?
Rate each from 1 to 5. 1 = no information, 5 = well informed.

SN	Information	Source	Rank
1	Access to farm inputs		
2	Planting methods & Spacing		
3	Use of appropriate fertiliser and pesticides		
4	Disease & insect control		
5	Access to finance		
6	Access to packaging materials		

7	Post harvest handling techniques		
8	Market price		
9	Market requirements(standards)		
10	Training in business		

Source 1) extension 2) buyer 3) friends 4) magazines 5) farmers group

30) Major problems faced by farmers: Rank each from 1 to 5. 1 = not serious, 5 = very serious.

SN	Problems	Ranking
1	Small pieces of land	
2	Poor quality of seeds	
3	High fertiliser price	
4	High outbreak of pest and diseases	
5	Availability of recommended fertiliser	
6	Technical know-how and support	
7	Unreliable sources of water	
8	Processing units	
9	Poor feeder roads	
10	High transport cost	
11	Credit	
12	Low produce price	
13	No or limited market price information	
14	Limited alternative markets	
15	Costly labour	

31) Overall impression: Put a tick√

SN	Impression	Tick√	Reason
1	Risky but profitable		
2	Risky but unprofitable		
3	Not risky and profitable		
4	Not risky and unprofitable		

Thank You

Survey on Buyers

Good morning/afternoon. Your participation is vital to the success of this study. This study is voluntary, and you may decline to answer specific questions. You also may end the interview at any point. Personal identifiers such as name and address will be held in confidence and will not be released to the public. The information will help researcher understand efficiency of tomato supply chains accessed by smallholder farmers. I will be grateful if you could assist me in filling out this questionnaire in as honest a manner as possible.

General information

Name of the department: _____

Position of the Responded: _____

Business Phone: _____

Date of the questionnaire: ____/____/_____

Q. 1
Please indicate the nature of the business unit

Hawker ☐ Small shops ☐ Supermarket ☐

Processor ☐ Wholesalers ☐

Q. 2
a) How long have you been involved in buying tomatoes? .....years

b) From current transaction,
i)What price do you pay US$/kg? .....

ii) What price do you charge US$/kg?.....

iii) What is the average quantity of product do you buy per each transaction Kg.....

d) For your local tomato produce, what is your source and how often do you buy?

SN	Source	Frequency of purchase	Percentage
1			
2			
3			
4			
5			

Source: a) large commercial farmers b) small commercial farmers c)
Frequency: daily b) more than once per week c) once per week d) once per week c) Other...

e) How much of your supply comes from contracts and how much do you source through exploratory trips where you buy there?

Contracts: %

Exploratory: %

Q.3
How much advanced notice do you give when buying produce?

a) None b) one day c) 3days d) one week e) two weeks f) other specify.....

Q.4
a) Have you previously or operating under a contract with a farmer or farmer group?

No Yes

b) If yes, what were the reasons for the termination of contract?

.....

.....

.....

.....

c) How do you resolve contractual disputes with farmers?.....

.....

.....

.....

d) What do you consider to be the most important aspects in your contracts with farmers? Rank 1 to 5. 5 = most important

SN	Service	Yes
1	Payment of credit	
2	A fair price is negotiated	
3	Produce is readily available to be collected	
4	Farmers are more responsive to buyer needs	
5	Other Specify.....	

Q. 5
Do you provide any of the following to farmers?

SN	Service	Yes
1	Agro-inputs(seeds, fertiliser, pesticides)	
2	Advice on good farming techniques	
3	Post harvest handling	
4	Finance (loans, advanced payment, grant)	
5	Market information (demand, price)	
6	Training in developing an agribusiness	
7	Other (specify.....)	

Q. 6

How do you usually pay the producers?

a) Advance payment (Specify %:.....) b) Cash c) 15-30 days

d) 30-90 days

Q. 7

What are the main constraints you face in sourcing from local producers? Rank 1 to 5. 1 = worst

SN	Service	Explanation	Ranking
1	Low quality		
2	Inconsistent supply		
3	Low supply		
4	Poor road infrastructure		
5	Poor post harvest technology		
6	Poor variety		
7	Other (specify.....)		

Q.8

a) How do you get sample for quality assessment (Do you request samples, do you make a field visit...)?.....

.....

.....

b) Would you rather buy produce already graded or do you prefer to grade yourself?

Buy already graded Grade myself

c) How much local produce do you reject? Percentage of total supply.....

d) What criteria are most important when you are grading tomato?

Rank 1 to 5, with 5= most important

SN	Variable	Ranking
1	Produce's colour	
2	Produce's size	
3	Produce's cleanliness	
4	Lack of bruises or damage from pests	
5	Other (specify.....)	

MARKET ACCESS FOR SMALLHOLDER TOMATO FARMERS IN MASHONALAND EAST PROVINCE OF ZIMBABWE: AN ECONOMIC ANALYSIS

By

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(2011-21-119)

ABSTRACT OF THE THESIS

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ABSTRACT

Linking small primary producers with markets has been identified as one of the major issues in policy and practice in improving livelihoods for millions of poor in Zimbabwe. Hence this study assessed the current market situation as a way of tracking and tracing efficacy and efficiency failures leading to more informed decision making with regard to redesigning of the matching market for smallholder farmers. The objectives of the study were to identify the tomato supply chains, analyse the price behaviour of tomato, assess the economic performance of the major supply chains, evaluate the institutional innovations in the supply chains and suggest viable supply chain options for smallholder tomato farmers in Zimbabwe. Tomato crop was chosen for the study as it is among the most important vegetables grown by smallholder.

The study was based on both primary and secondary data. The study was conducted in Mashonaland East Province. Primary data were collected by means of formal interviews and structured questionnaire from farmers, market-intermediaries and government officials. Multi-stage random sampling technique was used for sample selection.

Descriptive analysis was employed to provide a snap shot of the situation under study, which consisted of household level information. The Random Utility Model was employed to determine the factors which significantly influence the market accessibility. The price behaviour was studied using the techniques of classical time series. The Supply chain mapping was done to identify the actors. The study employed Data envelopment analysis to assess economic performance of supply chains and allocation of resources.

Volume mapping results indicated that the supply chain, which involved hawkers, was handling the largest volume of tomatoes approximately 409.4 tonnes in one production cycle in 2013 season. The chain that included wholesalers/processors was the least in terms of quantity handled (39.4 tons) showing that it was not accessible. Data envelopment analysis results indicated that the chain that included wholesalers and processors was the only efficient chain when constant return to scale was assumed. Supermarket chain was efficient when variable returns to scale was assumed. The chains that included passers-by

and hawkers were inefficient under both constant returns to scale and variable returns to scale technologies.

The seasonal index results showed that the tomato prices were highest and lowest in July and November respectively when prices were 31 percent higher than the annual average price and 43 percent below the annual average price. Spatial markets were not efficient in the short run although showing stable equilibrium in the long run. The price changes were transmitted from one market to another at a rate between 22 percent and 24 percent in the short run which proved to be low. There was no centre market among six municipal markets since price changes were to be set around more than one market.

Random Utility model results showed that credit, greenhouse and cooperative membership were significantly influencing participation of smallholder farmers in formal markets. Data envelopment analysis results showed that farmer, on average could reduce input consumption by 12 percent and 27 percent at production and marketing stages respectively.

The study concluded that the opportunities to improve profits lie in the marketing perspectives rather than production for tomato producers under study. Farmers can gain better income by reducing consumption of inputs without necessarily asking for high prices. The higher market price cannot compensate the value loss incurred by the high level of transaction costs. Tomato producers should pursue the low transaction costs marketing chains rather than ask for a higher market price. The chain that included hawkers should be given due attention and modern market infrastructures should be established in rural areas in order to relay reliable, relevant and correct information to the farmers.