ASSESSMENT OF MAGNITUDES OF TRANSACTION COSTS AND THEIR EFFECT ON SMALLHOLDER FARMER PROFITABILITY IN KIAMBU-NAIROBI LEAFY VEGETABLE SUPPLY CHAINS

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DECLARATION

This thesis is my original work and has not been presented for the award of a degree in any other university.

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DEDICATION

To my father, Dr. Barrack Okoba PhD, EMOD.

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ABSTRACT

Increasing urbanization in sub-Saharan Africa has resulted in a high value supply chain that has attracted rural vegetable farmers to participate in it. In Nairobi, existence of transaction costs along this chain has led to some leafy vegetable farmers being locked out from direct urban market participation. Consequently, they have chosen other market arrangements to ensure they are profitable. Using data collected from a sample of 111 farmers in Lari and Juja sub-counties, this study aimed to assess the effect of varying magnitudes of transaction cost on farmer profitability. The Heckman two-stage selection model was used to observe the effect of transaction costs on choice of market arrangement and farmer profitability. The results showed a significant negative relationship between time spent gathering information and direct participation in the urban market. However, time spent monitoring transactions and direct costs incurred negotiating with other actors had a significant positive relationship with direct participation in the urban market. Only transaction costs incurred during searching for information on market prices and nature of demand had a significant positive relationship with profitability. Improving access to market and price information by utilizing use of mobile or text message services would reduce the time spent thereby minimizing transaction costs incurred searching for market information. Further, policies that will facilitate establishment of institutions to facilitate beneficial negotiation and monitoring of transactions among actors will improve farmer participation in profitable urban markets.

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List of Abbreviations and Acronyms

AGRA - Alliance for a Green Revolution in Africa.

ASDS - Agricultural Sector Development Strategy

Dep. Var - Dependent Variable

FTCs - Fixed Transaction Costs

IFAD - International Fund for Agricultural Development

Ind. Var - Independent Variable

NIE - New Institution Economics

OLS - Ordinary Least Squares

PTCs - Proportional Transaction Costs

SDGs - Sustainable Development Goals

SSA - Sub Saharan Africa

TCE- Transaction Cost Economics

CHAPTER ONE

INTRODUCTION

1.1 Background

Africa is considered the most food insecure continent, characterized by low agricultural productivity, low rural incomes, and high malnutrition (AGRA, 2016). With the unprecedented demands of a high population growth rate and the increased rate of urbanization, the ability of African smallholder farmers to meet this growing market has been questioned (IFAD, 2016). As a result, the state of smallholder agriculture in sub-Sahara Africa (SSA) has attracted significant research attention. Increasing agricultural productivity and encouraging smallholder commercialization has been labelled as an important measure in improving welfare of Africa's rural and urban inhabitants (IFAD, 2016; AGRA 2017). Kenya relies on an agricultural sector driven economic growth (ASDS, 2010). However, smallholder horticulture farmers who contribute more than 70 percent of Kenya's horticultural output face barriers to commercialized production (McCulloch & Ota, 2002).

Leafy vegetable production in Kenya is characterized by higher levels of perishability in comparison to other food crops such as maize (Deloitte, 2015), geographical disparities among actors and the rapid emergence of high value supply chains (Tschirley *et al*., 2008). In addition, changing consumption patterns[1], awareness on improved nutrition and improving incomes has made leafy vegetables an essential food commodity for the urban population in Kenya (Irungu,

[1] Consumption preferences move from starchy inexpensive foods to a greater variety of expensive foods such as fruits and vegetables as income increases. Refer to Bennet's law, The Economics of Agricultural Development; world food systems and resource use (Norton *et al*., 2006)

2007). However, diversity of income status among Kenya's urban population provides an impetus for a well-coordinated leafy vegetable supply chain. This is because inadequate supply chain coordination leads to distorted prices, price variations, high prices and ultimately market failure (IFAD, 2001). For urban poor households, these inadequacies are disadvantageous since combined with having a high vegetable price elasticity of demand[2], spending a greater share of their income on leafy vegetables has a high opportunity cost relative to starchy foods due to their low energy content[3]. Supply chains that offer affordable prices for this group of consumers are therefore essential in curbing micronutrient deficiency[4] in low-income urban areas. Nevertheless, dynamics of food supply chains such as actor integration, coordination challenges and contractual hazards provide the need for various governing structures that coordinate transactions among actors (Hobbs, 1997; Masten, 2000; Poulton *et al*., 2006).

Dorward *et al*. (2009) stated that the set of rules and governance structures that allocate exchange among actors through specific transactions are identified as institutional arrangements. The study differentiates various institutional arrangements that govern specific transactions and name them as; gift exchanges, hierarchies and market arrangements. Despite acknowledging the blurriness in distinguishing them, the study stated there is increased precision in content of exchange, decreasing emphasis on the relationship between parties transacting and decreasing interactions between different transactions involving the same parties as one moves from gift

[2] Vegetables are not a staple food crop in Kenya.
[3] Nutrition based poverty trap shows how today's income will allow one to buy food (that may or may not give you adequate energy) thus allowing one to earn tomorrow's income. This relationship for poor households who rely on manual jobs with high energy requirements is critical (Banerjee & Duflo, 2011).
[4] Studies show vegetables are a rich source of of vitamin A, C and Iron which are the most prevalent in micronutrient deficiency in Kenya (Maundu *et al*., 1995; Imungi, 2002; Ministry of Health; Nutrition on the Rise: Raising Kenya's future, 2015)

exchanges to market arrangements. Other authors have identified institutional arrangements based on level of farmer participation and benefits received (Oakley, 1991; Mburu & Wale, 2006).

Studies on vegetable supply chain in Kenya identify market arrangements, as the most common type of institutional arrangement among transacting parties (Irungu, 2007; Tschirley *et al*., 2008; Omiti *et al*., 2009). However, Kenyan agricultural supply chains have been labeled poorly coordinated with areas of surplus and shortage coexisting. Yet, smallholder farmers are often unable to take advantage of these gaps due to market failure (Alene *et al*., 2008). Farmers who try to bridge these gaps incur costs as they hope to reduce the risk of market transaction failure (Poulton *et al*., 2006). These costs commonly referred to as transaction costs, have been labeled by some researchers as the most significant barriers to smallholder market participation (Holloway *et al*., 2000). To that end, transaction costs have been categorized based on the set of activities that lead to their incurrence such as sourcing for market information and reduction of risks and uncertainties among actors (Williamson, 1985).

1.2 Problem Statement

In Kenya, many barriers in the vegetable supply chain limit effective access to markets. Examples of these barriers are imperfect information among actors, information asymmetry, market price uncertainty, lack of recognized grades and standards and poor infrastructure (Tschirley *et al*., 2008). Consequently, important linkages in this supply chain that normally reduce transaction costs and increase profitability of enterprises are inaccessible to smallholder vegetable farmers in particular. The result of this inaccessibility is manifested by poor understanding of market opportunities, prices, buyers, grades and standards by farmers (Omamo, 1998). These factors increase the cost of information and time spent negotiating and enforcing any forthcoming

contracts among actors (Mmbando, 2014). Sometimes, transaction costs can increase total costs incurred by a farmer such that they exceed total revenue. As such, farmers with limited operating capital often make the rational decision not to invest in potentially profitable inputs reducing their productivity and limiting their participation in markets (Jagwe *et al*., 2010; Mmbando, 2014). It is therefore imperative to determine how levels of transaction costs vary in different institutional arrangements, in the supply chain and their effect on profitability of farmers and their incentive to participate in urban markets. Available studies on vegetable supply chains in Kenya have not used empirically quantified transaction costs to show how these costs vary and influence profitability among farmers (Mburu *et al*., 2003; Irungu, 2007; Tschirley *et al*., 2008). Therefore in order to contribute towards filling this gap in knowledge this study adopted a Transaction Cost Economics (TCE) framework to empirically assess the magnitudes of transaction costs and their effect on profitability of smallholder vegetable farmer in the Kiambu-Nairobi leafy vegetable supply chain.

1.3 Objectives

The overall objective of this study was to assess how various magnitudes of transaction costs are constituted in institutional arrangements and how they affect smallholder farmer profitability in the Kiambu-Nairobi leafy vegetable supply chain. The specific objectives were:

1. Identify the characteristics of institutional arrangements in the leafy vegetable supply chain.
2. Determine the magnitudes and variations of transaction costs of leafy vegetable smallholder farmers in the leafy vegetable supply chain.
3. Analyze the effects of transaction costs on leafy vegetable farming profitability for smallholder farmers in this leafy vegetable supply chain.

1.4 Hypothesis

Transaction costs have no effect on leafy vegetable farming profitability for smallholder farmers in the leafy vegetable supply chain.

1.5 Justification

The Kenya government came up with the Agricultural Sector Development Strategy (ASDS) aiming to make the agricultural sector a key driver for achieving 10 percent annual economic growth rate as anticipated through the economic pillar of Vision 2030. In addition, it hopes to align this and other objectives to those of the global development goals namely the Sustainable Development Goals (SDGs) to ensure a better society for posterity. To achieve this, smallholder farmer commercialization has been identified as a key area for improved growth and investment (AGRA, 2017).

The core of New Institutional Economics (NIE) is normative analysis of contexts under study. Guided by the first objective, this study aimed to highlight characteristics of existing institutional arrangements in the leafy vegetable supply chain. This characterization is essential as the government and other parties will have a clear level of benchmarking between what exists and what institutional arrangements should exist. Ultimately, this will improve the efficiency of supply chains and resource allocation by the government towards supporting effectiveness of institutional arrangements and consequently meeting its defined objectives and those of SDG 2 and 3 on zero hunger and good health and wellbeing.

Similarly, determining the magnitude and variations of transaction costs of leafy vegetable smallholder farmers is important as it shed lights on trade-offs made by farmers in institutional arrangements. If transaction costs in a supply chain are high, farmers may not participate in it regardless of the benefits they stand to gain (Poulton *et al*., 2006). The expected output from this objective will allow for informed interventions by various bodies and involved government parastatals in curbing attributes of this costs that are prevalent in market exchanges. This action will incentivize profitable market exchanges which will lead to increased incomes and better livelihoods and thus, assist in meeting Goal 1 of the SDGs on 'No poverty'.

From the final objective of this study, the importance of its finding is highlighted by the projections for sustainable food security in urban areas of Kenya. Studies show that marketed food production per rural households needs to grow by nearly 3 percent per year to meet urban demand (Tschirley *et al*., 2008). The government can therefore create policies to ensure correction of market failure, provide infrastructure and an overall enabling environment to allow actors coordinate their activities. Such interventions outcome will assist the government in not only realizing reduction in the current levels of poverty but also improved health and well-being of the urban consumer population.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed empirical and theoretical literature relating to transactions cost, smallholder farming, profitability in marketing channels and structure and operations of food supply chains. Debates on issues in transaction costs and their characterizations, characteristics of smallholder farmers and institutional arrangements were also reviewed. Finally, marketing strategies among commercializing smallholder farmers in supply chains and their profitability were discussed.

2.2 Structure and Functions of Supply Chains

2.2.1 Participants and their Functions in a Supply Chain

The World Bank's strategy on rural development report describes smallholder farmers as those with a low asset base and operating less than two hectares of cropland (World Bank, 2003). Alene *et al*. (2008) based their description of smallholder farming based on the incurrence of transaction costs. These authors termed smallholder farmers as those whose participation in markets are adversely affected by transaction costs. Other characterizations of smallholder farmers have been their locations in rural remote areas, lack required information on means to locate better markets, limited access to factors of production and credit (Makhura, 2001; Ortmann, 2010).

Intermediaries also referred to as traders or brokers are another key group of actors operating in the agricultural supply chain (Mburu & Wale, 2006). Some studies on market channels and farmer-market accessibility refer to intermediaries as the linkage between farmers and

consumers (Oguoma *et al*., 2010). This group of actors are said to operate in the supply chain through a risk absorbing component for the risk averse buyers and sellers (Driel, 2003).

Consumers also form an important part of the supply chain. Their wants and preferences determine the structure and conduct of a particular supply chain (Bjorndal *et al*., 2016). Gebresenbet and Bosana (2012) show that consumer preference for good quality food provides incentives for improvement in supply chain actor integration and food logistics systems. Relatedly, Reardon and Timmer (2012) show that the focus of food supply chain has moved from commodity centered to a quality oriented system in various urban food markets globally. They argue that this move has created a ripple-effect throughout the food supply chain that has resulted in uptake of new technology among actors and improvement in coordination over stages.

Another key actor in an agricultural supply chain is the state. Based on the type of state intervention in the supply chain, various outcomes can be realized. An intervention such as improving rural road networks, markets and communication infrastructure raises the confidence of private players to invest in various segments of the supply chain (Poulton *et al*., 2006; Kyeyamwa *et al*., 2008). On the other hand, some interventions such as local taxes and restrictions on cross-border trade might ultimately reduce the profits of private actors or reduce the profitability of farmers (Kyeyamwa *et al*., 2008).

Other supply chain actors who provide support services include warehouse providers, processors and transporters. Gebresenbet and Bosana (2012) state that these actors have key roles to play in ensuring that supply chain linkages across segments are effective. Reardon and Timmer (2012) extend the importance of these actors by showing how their roles in ensuring effectiveness, consequently improves the movement and quality of food in the supply chain. Since food quality

in a supply chain has many influencing factors such as method of loading and unloading during movement, facility location, routing and scheduling of transportation it is important for collaborative relationships to be built across supply chain segments that will assist in improving the chain's effectiveness and efficiency (Manzini & Ricardo, 2013).

2.2.2 Conduct, Structure and Performance of an Agricultural Supply Chain

Supply chains allow for the physical, financial and information flow of a given product among trading partners to ultimately fulfil customer demands (Jafee *et al*., 2010). For an agricultural supply chain therefore, the following definition from the same authors describe it as "an agricultural supply chain encompasses all the input supply, production, postharvest, storage, processing, marketing and distribution, food service, and consumption functions along the "farm to fork" continuum for a given product (be it consumed fresh, processed, or from a food service provider), including the external enabling environment."

Reardon and Timmer (2012) provide explanations that an agricultural supply chain structure is measured by degree of market consolidation, investment from foreign sources and market power. They continue to describe that conduct of a supply chain is observed through technology adopted, institutions existing among actors and these actor's organization in both their respective and across other segments. The dual effectiveness of these two components ensures improving supply chain performance.

As the structure of food supply chains in developing countries continues evolving, Porter (1985) advocates for governance mechanisms to improve their performance. These mechanisms should drive down transaction costs, enhance coordination and improve food quality. These governance apparatuses include setting, monitoring, and enforcement of coordination mechanisms

such as contracts, cooperatives, grades and standards. Similarly, Fischer and Qaim (2012) and Barrett (2008) provide insights on SSA food supply chain by proposing collective action among farmers to ensure better spread of benefits among them as they are often the most exploited. In support of these findings, Bhattarai *et al*. (2013) state that effective interlinkages allow for a robust supply chain. This is one that provides smallholders with several sustainable market arrangements for marketing of their produce. Ultimately this will spur competitiveness and drive supply chain performance.

2.2.3 The Role of Transaction Costs in a Supply Chain

In literature, transaction costs which are costs incurred searching for market information, bargaining, monitoring, enforcement and compliance of a market transaction have been re-categorized as either ex-ante or ex-post costs based on when they are incurred in a transaction process (Mburu *et al*., 2003). Searching for market information, bargaining and contracting costs have been classified as ex-ante costs as they occur before a contractual arrangement is in place while monitoring, enforcement and compliance cost are the ex-post costs as they are incurred after the contractual arrangement has been made.

Key *et al*. (2000) have also characterized these costs into fixed and variable transaction costs. Fixed transaction costs (FTCs) across the food supply chain are not determined by the volume of output merchandized through it. They include the costs of (a) searching for a trading partner, (b) negotiating and bargaining, and (c) enforcement of contracts and supervision, where credit sales are involved. This is because sellers have to lower the likelihood of defaults (Kirsten & Vink, 2005). Variable or proportional transaction costs (PTCs) on the other hand are per unit costs of accessing markets. These costs vary with the volumes traded and may affect the decision

to participate in the market as well as the amount traded. They include costs associated with moving the output being traded, such as transport costs and time spent distributing the product to the market. Thus, the variable transaction costs increase the real price of the commodity purchased and lower the real price received for commodity sold in a food supply chain.

Fischer and Qaim (2012) categorized transaction costs as either internal or external. The authors argue in most contexts, smallholder farmers have minimized internal transaction costs due to focus on family labor. This is because monitoring and compliance costs that would be associated by hired labor are not incurred. External transaction costs are incurred by smallholder farmers to obtain information on inputs, markets and negotiation with other chain actors such as brokers and transporters.

2.3 Factors Contributing to Various Magnitude of Transaction Costs in Smallholder Agriculture

The optimism associated with globalization of agricultural trade has been tempered due to stringent requirements that farmers have to observe in the supply chain (Markelova, Meinzen-Dick, Hellin & Dhorn, 2009). To meet these requirements, farmers incur transaction costs of various magnitudes depending on their production and market arrangements (Jagwe *et al*., 2010). Scholars have pointed out that drivers of transaction costs are distinguished by their attributes (Mburu *et al.*, 2003; Bhattarai *et al*., 2013). These drivers of transaction costs have been identified as; asset specificity, uncertainty, frequency and complexity (Williamson, 1991; Mburu *et al*., 2003).

Other factors have also been identified by several authors contributing to varying magnitude of transaction costs. Renkow *et al*. (2004) in their study with semi-subsistence farmers found that transaction costs rise with distance from markets, from 19 percent at one kilometer from

a principal market to 58 percent at 48 kilometer distances. Similarly, Cadot *et al*. (2006) reports that for rice farmers in Madagascar, the transaction costs associated with market participation are equivalent to 124-153 percent of their total annual production. The study associates these costs to price uncertainty, lack of assets, and remoteness of farms. In Uganda Kyeyamwa *et al*. (2008) shows that livestock farmers incur high transaction costs for every trip made (which may be several times before a sale is made) and also based on the distance covered to markets.

Jagwe *et al*. (2010) provide evidence how poor infrastructure is hampering banana farmers in the Central Africa region from effectively participating in markets. In this case, poor infrastructure reduces the frequency of farmer market participation and increases the complexity of transacting. Thus the drivers frequency and complexity emerge as the most distinctive influencing factor to high transaction costs for this particular group of farmers. Fischer and Qaim (2012) showed that for a farmer close to a major tarmac road, they may not be affected by poor infrastructure but rather imperfect information on market prices. In this case, uncertainty becomes the most distinctive driver of transaction costs. The narrative that is realized from these studies is that most factors that lead to the incurrence of transaction costs can be converged to the four drivers of transaction costs. Therefore, a review of studies focusing on these four drivers of transaction costs follows.

2.3.1 Asset Specificity

This particular attribute of transaction costs has been postulated to arise when one party in a transacting process invests in assets that have little or lack value in a different use (Hobbs, 1996). For example, an asset such as a refrigerated truck for transporting vegetables would have very limited uses outside vegetable transportation. Poulton *et al*. (2006) when looking at coordination problems due to asset specificity among smallholder farmers in SSA affirmed this claim. They

stated most agricultural investments in SSA require complementary investments by other market players who may lack the goodwill to do so or may exploit another actor if there are no proper contractual arrangements (Klein *et al*., 1978). This finding shows that despite a smallholder investing in inputs as is widely asserted by scholars (Jayne *et al*., 2011), if there is no coordinated investment with other actors in a supply chain or there are hindrances in selling this increased output, farmers may opt out of a supply chain despite its potential profitability. However, in some cases, farmers will not opt out of the supply chain; instead they choose to protect themselves against transaction failure that may arise due to these transaction risks. By doing this, they incur higher transaction costs in making contractual arrangements that safeguard any investment in their enterprise (Ortmann & King, 2010).

2.3.2 Uncertainty

This attribute of transaction costs is defined as the unexpected variations in circumstances surrounding a transaction. Kirsten *et al*. (2009) observes the dual role of buyers and sellers in reducing uncertainty around a transaction due to information asymmetry. Sellers know more than buyers with regards to availability and characteristics of products they are selling, and buyers have additional information than sellers with regards to their type of demand and ability to purchase produce. Both parties therefore search for the missing information to reduce uncertainty surrounding the transaction. This aspect of transaction costs is similarly seen from (Kyeyamwa *et al*., 2008). The authors found that in livestock markets, traders had better market intelligence on pricing mechanisms based on livestock quality and grades than farmers due to ineffective institutional arrangements. This resulted in farmers selling their livestock based on prices provided by these traders and losing out as they had no basis to bargain. Nonetheless, the authors described cases where farmers incurred high information and search costs of veterinary services in order to

ascertain the quality of their livestock. Jaffee (1995) brings another argument on uncertainty by stating that unexpected changes surrounding a transaction may come up due to environmental or behavioral risks. Environmental risks occur when suppliers are otherwise trustworthy but unable to honor the terms of trade due to exogenous factors such as change in weather conditions (Bhattarai *et al*., 2013). In most cases, smallholder farmers may lack adequate capacity to mitigate adverse changes in farming conditions and hence such a risk is a frequent occurrence in their trading relationships (Vorley *et al*., 2009).

Behavioral risks, on the other hand, occur when one party in a transaction alters its behavior after a contract has been agreed. This kind of pervasive opportunism exhibits as lack of trust among actors (Bhattarai *et al*., 2013). Masuku and Kirsten (2003) in their assessment of the role of trust in the performance of a supply chain enhanced this argument by showing that the element of trust in a relationship among actors is essential in enhancing economic benefits of farmers. If an actor lacks trust in a transacting relationship they may doubt the degree of benefits that will come forth from it and result in opportunistic behaviors like side selling. The presence of this opportunistic behavior gives rise to transaction costs incurred in monitoring behavior to prevent breach of contract and the subsequent enforcement (Grover and Maholtra, 2003; Mburu *et al*., 2003).

2.3.3 Complexity

Jaffee (1995) and Poulton and Lyne (2009) explained this driver of transaction costs among smallholders by alluding to perishability of products, specificity of quality standards, seasonality of supply and traceability requirements as factors leading to complexity of transactions. Thus, transaction costs increase in such a scenario when costs of acquiring information and monitoring contracts have to be incurred.

Despite contractual arrangements being used to mitigate this attribute of transaction costs, Kirsten *et al*. (2009) argue that contracts are incomplete due to bounded rationality among the actors involved. Hence, this and the non-verifiability of relevant variables necessary to make contracts complete consequently mean that they are continuously renegotiated and redesigned to advance greater efficacy hence incurring of renegotiation cost *ex post* occurs.

2.3.4 Frequency

Transaction costs increase with frequency of economic transactions among various actors due to search, negotiation and monitoring costs involved with each market exchange (Bhattarai *et al*., 2013). However, where recurrent transaction with one partner happens in a supply chain over time, the resulting effect is reduction of transaction costs. This is because expressions of friendship, common values and mutual respect are fostered among actors and hence trust develops (Peterson, 1999). However, recurrent transactions may also allude to a supply chain that is not robust and is undeveloped hence lacks alternative trading options (Bhattarai *et al*., 2013). This is, unfortunately, the rule rather than the exception in most SSA countries as markets are not wide enough (Dorward *et al*., 2009).

2.4 Role of Institutional Arrangements in Smallholder Agriculture

The *ex-ante* choices of governance structures are prescribed to attenuate the *ex-post* hazards of strategic behavior among actors in a market arrangement (Wiliamson, 1998). In SSA agricultural setting, coordinated market mechanisms (through transaction cost reducing institutional arrangements) are considered appropriate to develop smallholder agriculture by reducing exposure to transaction risks (Kirsten *et al*., 2009).

In portraying potential bottlenecks in both backward and forward integration in market arrangements, Escobal and Cavero (2012) asserted that backward integration from processors to farmers generates incentive problems among farmers and poses high supervision costs for processors. In most cases, processors will seek to monitor that the crop is being planted as per agreed standards and the harvest is of the agreed quality. Moreover, forward integration from farms into processing is difficult in most situations due to the inability of an individual farm to economize on scale. In such instances, Williamson (2003) made a case for collective action among farmers to allow forward integration from production into processing and distribution.

Another institutional mechanism that has been postulated to improve smallholder participation in supply chains is contractual arrangements in cases of high uncertainty in a market exchange (Hudson & Lusk, 2004). This need for contractual agreements among actors has been highlighted as an important governance structure with regards to positively influencing smallholder market participation when market failures are substantive (Key & Runsten, 1999). Likewise, Ortmann and King (2010), propose that vertical coordination among actors with either formal or informal variations of contracting is a worthwhile response to high transaction costs that are associated with hold-up problems due to asset specificity.

2.4.1 Characteristics of Institutional Arrangements in Supply Chains

Dorward and Omamo (2009) observed that in the action domain of an institutional framework, actors can either be a single individual or an aggregate group[5] that makes decisions based on the influence of individual actors within them. The relationships among actors and the contractual arrangements thereof is what they argued to be the cause of the difficulties faced in describing and understanding institutions and their attributes. Nonetheless, some scholars have gone ahead to characterize institutional arrangement based on particular contexts of study.

Mburu and Wale (2006) characterized institutional arrangements between farmers and stakeholders involved in conservation of crop genetic resources based on the type of organization mobilizing farmers and the factors leading to their emergence. They came up with three types of contractual arrangements based on the levels of farmer participation and benefits drawn from activities. These contractual arrangements are informative, interactive and consultative. Farmers mobilized by traders, advocacy groups and those that self-mobilized had an informative type contractual arrangement. Farmers who were organized by research organizations had interactive and consultative types of contractual arrangements. Further, key driving forces in these institutional arrangements were need for market access and collective action due to homogeneity. Likewise, Ostrom *et al*. (1994) found that natural resource management coordination activities in local arrangements relied on the social cohesion of actors involved. Mburu *et al*. (2003) concurred with this argument by observing that the ability of a local arrangement between landowners' and state agencies to effectively reduce transaction costs is based on their social capital.

[5] Household, different social groups, economic and user associations, firms and state agencies.

One aspect that makes institutional arrangements and their respective characterization differ is the type of agricultural commodity that a supply chain specializes in (Poulton *et al*., 2005). Fruits and vegetables which are considered 'high value' due to the costs associated with their logistics in the supply chain will require a higher degree of coordination, stringent rules enforcement, and monitoring of actors as compared to staple food crops which are less perishable in comparison to the former (Poulton & Lyne, 2009; Markelova & Mwangi, 2010). The work of Kyeyamwa *et al.* (2008) show ineffective institutional arrangements lead to farmers incurring high transaction costs due to lack of uniform guidelines that structure grades and standards of livestock. They further show how various aspects of this institutional arrangement may result in higher transaction costs. For example, farmers may incur costs to ascertain different metrics used to price their livestock such as carcass weight, yield, grade, and pedigree.

Barrett (2008) in his study of market participation by smallholders in East and Southern Africa observes that producer organizations are an essential element in supply chain simplification for poor farmers in developing countries. Producer organizations connect smallholder farmers directly to high volume markets through a bulking function and bypass intermediaries in various segments of the chain. In addition, they provide farmers with a cheaper alternative when searching for market information, negotiation, monitoring and enforcement of exchanges (Bernard & Spielman, 2009). However, this particular institution as has been noted by Barrett (2008) and Markelova and Mwangi (2010) may not be efficient with regards to minimizing transaction costs in some contexts. For example, low homogeneity of members in a group may lead to high transaction costs due to increased internal monitoring through numerous bylaws and accountability measures. Therefore, marginal benefits from collective action relative to high transaction costs associated with organizing are much lower. Innovative institutional arrangements such as vertical

and horizontal coordination have also been found necessary for SSA food supply chains. Kyeyamwa *et al*. (2008) noted that to enable livestock farmers in Uganda access profitable tertiary markets as opposed to primary collection centers (farm-gate), farmers needed to improve their coordination thus increase their scale and bargaining power.

Contractual arrangements between farmers and other actors in the rural-urban supply chain have become widespread due to the high demand of food in urban areas and the need to satisfy it adequately (Kaganzi *et al*., 2009). In such cases and particularly for poor farmers in rural areas, simple, endogenous and understandable rules of engagement are preferred as they require less effort to monitor behavior (Agrawal & Gibson, 1999; Mburu & Wale, 2006). Further, Dorward *et al*. (2009) discussed high social capital among smallholder farmers and local traders as essential in building beneficial exchanges. They proceeded to observe that in SSA, inability to afford legal enforcement mechanisms makes trust an important monitoring and enforcement mechanism when conducting business with other supply chain actors. This will require successful repeated exchanges that ultimately lead to reduced screening and monitoring costs for them in the supply chain. However, despite the benefits of reduced transaction costs due to this relational contracting, trust-based enforcement mechanisms do limit growth of markets and robustness of supply chains as it is too risky to engage with different actors whose intentions may be unclear (Dorward *et al*., 2009).

2.4.2 Farmer and Farm Characteristics and their Influence on Transaction Costs

Renos *et al*. (2003) suggest that the extent to which a farmer can lower transaction costs is usually decided by individual characteristics such as education, skill and gender. In their study on smallholder maize market participation under transaction costs in Kenya, Alene *et al*. (2008) found that market participation declines with age. This was contrary to their hypothesis that expected older farmers to have greater market contacts hence allowing them to have lower transaction costs and participate more in markets. This belief may have been misinformed from the onset based on the assumption that older age is synonymous with experience in market participation. The work of (Mmbando, 2014) argues for experience in trading produce as a better indication of market contacts and trust development relative to old age. Similarly, that narrative agrees with Renos *et al*. (2003) who observed that experience trading improves ones negotiation skills and thus a higher likelihood to participate in tertiary markets. Ouma *et al*. (2010) found that years of banana farming experience is indeed positively related with the probability of participation and intensity of quantity supplied in a market; unlike age where the relationship was negative.

Formal education has been shown to influence a farmer's ability to acquire, process and effectively use market information from different sources to make informed decisions (Strauss *et al*., 1991). Makhura (2001), contrary to the above arguments, found that being more educated does not influence decisions to participate in markets but it negatively influences the likelihood of selling maize.

When looking at which assets will ultimately reduce transaction costs for smallholder banana farmers, Jagwe *et al*. (2010) found ownership of a bicycle is negatively linked to market participation. They alluded this finding to instances where transaction costs are exceedingly high hence ownership of any means of transport will not be of any influence in market participation

decision making. However, smallholder farmers who own transport assets are shown to face lower proportional transaction costs thereby increasing their level of market participation (Key *et al*., 2000; Jagwe *et al*., 2010).

Social networks of smallholder farmers have been highlighted by several scholars as key pillars in creation of institutions such as collective action (Markelova & Mwangi, 2010; Zanello *et al*., 2012). Davis (2001) portrayed economic agents as socially embedded. Thus, individuals, their institutions and social values influence each other. This influence of high social capital is portrayed through reduction of transaction costs, increased market access and participation, improved bargaining power and increase in farmer profitability (Grootaert, 1999; Narayan & Pritchett, 1999; Bienabe *et al*., 2004; Jari & Fraser, 2009; Mmbando, 2014).

2.5 Empirical Studies on Determinants of Supply Chain Participation

In the earlier sections, importance of increased market participation among smallholders has emerged as an essential prerequisite for agricultural transformation and commercialization because of its ability to improve livelihoods (Ouma *et al*., 2010). Conceptually, determinants of market participation can inform those of supply chain participation, as the former is part of the last-mile supply chain process (Jafee *et al*., 2010). As such, several factors have been highlighted by scholars as principal determinants of farmer participation in markets in SSA and other developing economies and by extension supply chains.

2.5.1 Improved inputs, technology and mechanization

Key *et al*. (2000) found solutions aimed at improving smallholder market participation should ensure accessibility to high yielding varieties and improved mechanization for increased agricultural output. Likewise, Kydd (2002) shows how strategic investment in asset-specific inputs

both horizontally among specific actors like traders and vertically, within the supply chain, would encourage high rates of agricultural productivity and consequently increased market surplus.

2.5.2 Physical Infrastructure

Williamson (1985) when postulating on the detrimental effects of high transaction costs highlighted distance to markets as one of these factors that influenced the magnitude of these costs in a supply chain. This narrative has gone on to be a topical point of research as evident in more recent studies. Ouma *et al*. (2010) researched on influence of transaction costs in terms of distance and cost of information to farmer market participation. The study found that banana farmers in Burundi and Rwanda located one hour from the nearest urban market lessen the sold quantities by 17 percent compared to those who live close to these markets. This finding conforms to that by Alene *et al*. (2008) who found that for maize farmers in Kenya located far from the markets, transacted quantities reduced by 62 percent. Komarek (2010) had similar findings with smallholder banana farmers in Kenya where distance to market adversely influenced choice to participate in markets. With regards to vegetable market participation in Kenya, Olwande and Mathenge (2011) found that distance to the tarmac road negatively influenced the decision to enter the market.

2.5.3 Socio-Cultural and Economic Characteristics

Komarek (2010) found that output price, yield, size of household, ownership of land and access to price information positively influenced intensity of market participation. Mather *et al*. (2011) in their study on the intensity of market participation in Kenya found that maize market supply intensity was positively influenced by use of hybrid seed, area planted, use of fertilizer, ownership of oxcart and radio. The same study when extended to Zambia found that the same factors as listed for Kenya did have a positive influence on the intensity of maize market

participation but on the other hand, gender and age of household head had a negative influence on the supply of maize to markets.

Olwande and Mathenge (2011) found membership to a farmer association, owning a mobile phone, price and geographic location positively influenced the decision to enter markets. On the other hand, lack of formal education negatively influenced the decision to enter markets. With regards to intensity of market participation among this same group of farmers, household size had a negative influence on the amount of vegetables supplied to markets.

Past studies on these socio-cultural and economic determinants of market participation provide extensive literature with regard to their effect on farmer market participation. Further, it can be argued that not all factors will certainly exhibit external validity outside their area of study. Context is essential due to arguments put forward on the different characteristics of smallholder farmers, their location, and assets. For example, Reyes *et al*. (2012) found that owning a means of transportation has a positive influence on quantity of potatoes sold by farmers. However, Ouma *et al*. (2010) and Chilundika (2011) found that ownership of a transportation asset has a significant negative effect to intensity of market participation. The former gave a plausible explanation for this as ownership of a bicycle or car was considered an asset for affluent households who could be participating in other ventures outside agricultural markets.

2.6 Review of Methods to Model Transaction Costs

Few studies have measured transaction costs (Kherallah and Kirsten, 2002). This may be the case because if transaction costs are considerably high in a market exchange, they may prevent exchange from taking place and costs cannot be empirically captured (Alene et al., 2008). Nonetheless, studies that have measured transaction costs, have resorted to observable factors and proxies that explain, or mitigate, transaction costs. These include; distance to output market, ownership of transport and communication assets, membership in marketing groups, intensity of research and development expenditures as a measurement of asset specificity and uncertainty as percent change in farm output supply in a particular period (Hobbs, 1996; Omamo, 1998; Alene et al., 2008; Huo, 2015; Moono, 2015).

In recent times, a more quantitative technique to model transaction cost has been used by some studies. Mburu *et al*. (2003) and Irungu, (2007) used direct expenses of sourcing for information, negotiation, monitoring and enforcing contracts and data on time spent in those activities to measure transaction costs. The argument raised was the time taken to undertake the above processes of a market exchange can be assigned a monetary value using a shadow wage rate for the opportunity cost of the farmer's time. However, Irungu (2007) used daily net profit from a farmer's enterprises as the proxy for the opportunity cost of time spent as opposed to shadow wage rate. This was informed by the fact that at the time of study, the daily net profits reported were much higher than the actual wage rates for labour.

Despite this quantitative way of modeling transaction costs being thorough, it has its shortfalls. This is because it is difficult to assign monetary values to all transaction costs. Hobbs (1996) aptly expressed this opinion when reviewing transaction costs in livestock markets. The argument raised were that costs such as those incurred through monitoring costs for grade

information asymmetry would be problematic to value in monetary terms. Further, unless information on the probability of an improper grade standard being applied to a carcass and an estimate of the average loss suffered by the farmer for this improper standard is routinely recorded, data requirements for such a scenario become unrealistic.

2.7 Review of Empirical Studies on the Effect of Transaction Costs on Profitability

Various studies have used profitability as a measure of farm efficiency (Li *et al*., 2012), household welfare (Bonabana-Wabbi *et al*., 2016), and of returns on inputs invested (Mutuma *et al*., 2014). However, studies focusing on factors influencing smallholder profitability are rare (Liverpool-Tasie *et al*., 2017). Some researchers have used gross margins to compare farm enterprise profitability using regression analysis, but few have attempted to identify the effects of different factors, particularly transaction costs, on the variations of these profits (Birthal *et al*., 2005; Mutuma *et al*., 2014; Bonabana-Wabbi *et al*., 2017). However, by recalculating the variables; Average Value Cost Ratio and Marginal Value Cost Ratios to their production function, Liverpool-Tasie *et al*. (2017) were able to assess the effect of transportation cost on profitability. Other researchers have used the Heckman two step model to identify the effects of transaction costs on intensity of marketed farm supply among other factors (Alene *et al*., 2008; Mmbando, 2014).

CHAPTER THREE

METHODOLOGY

3.1: Conceptual Framework

The conceptual framework (Figure 1) shows linkage between the institutional environment that influences the structure on which economic activities such as selling, buying, and negotiation are conducted within the market arrangements in the leafy vegetable supply chain. The institutional environment comprises of formal and informal grades and standards of produce in this high-value urban supply chain, expected human behavior such as opportunism, social norms such as trust and the power relations among actors in the supply chain.

Institutional arrangements comprise of the set or rules determined by the institutional environment that governs actor relationships in a supply chain such as the leafy vegetable. These arrangements, such as contracts, influence magnitudes of transaction costs experienced in the supply chain depending on their effectiveness in coordination, integration and enforcement mechanisms (Markelova & Mwangi, 2010). Some of the main actors in these arrangements are brokers, transporters, aggregators, middlemen and marketing organizations (Mburu & Wale, 2006; Irungu, 2007; Tschirley *et al*., 2008). Another aspect of these institutional arrangements is the attributes and characteristics of the actors and their influence on the set-up of any contracts among them (Dorward *et al*., 2009). If the arrangements are effective in minimizing transaction costs, the result is a profitable supply chain for farmers (Kherallah & Kirsten, 2002).

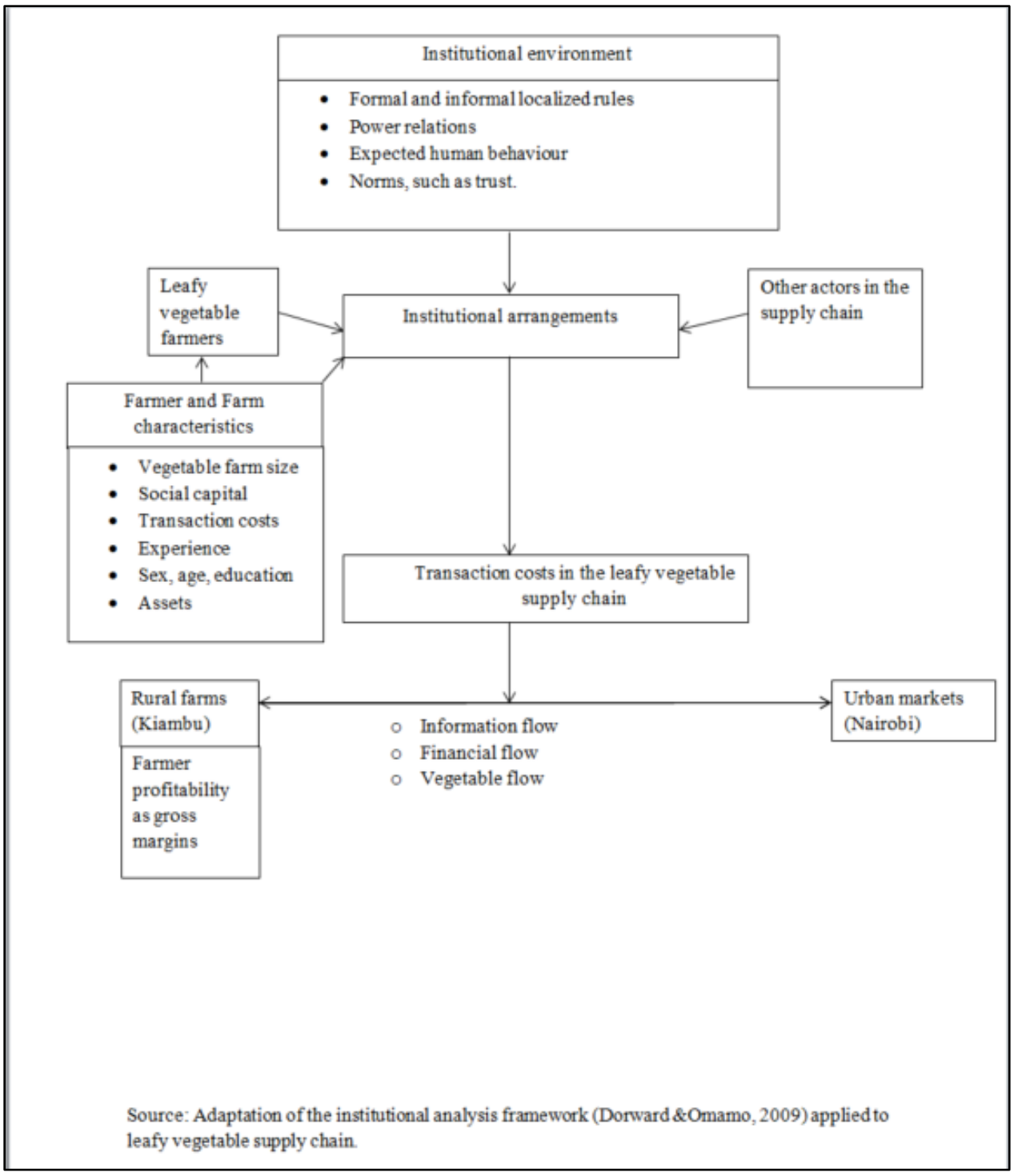

Figure 1: Interaction between farmers and transaction costs in a vegetable supply chain

3.2 Theoretical Framework

Both the neoclassical and new institutional economics literature postulates that the objective of any producer is profit maximization. For this objective to be achieved, costs can be reduced with revenue being constant. When observing market barriers and their ability to generate transaction costs, it is critical for both production and transaction costs to be studied simultaneously in order to not only observe the effect of these costs on profitability but to also determine the efficiency of institutional structures (Mburu *et al*., 2003).

In observing market barriers and generated transaction costs for farmers in a market exchange, Key *et al*. (2000) used an agricultural household model framework. This study found this agricultural household model attractive as it relies on market transactions which farmers easily recollected and secondly it provided for measurement of transaction costs influence as per household involved in market participation (Kyeyamwa *et al*., 2008). However, unlike the dual use of this framework in showcasing both the effects of transaction costs to sellers and buyers, this study will only consider transaction costs incurred through selling farm produce. Therefore, assuming leafy vegetables are good *i*, the household decides:

q_i = Amount to produce

c_i = Amount to consume

x_i = Amount to use as input for the next season

m_i = Amount to sell

Since the objective of households is to maximize utility and assuming there were no transaction costs, the household problem would be to maximize the utility function (Equation 3.1) subject to the cash constraint (Equation 3.2), the resource balance (Equation 3.3), and the production technology (Equation 3.4).

Equation 3.1 $=U(c_i; z_u)$; Household utility maximization.

U_i = Utility maximization

c_i = Amount to consume

z_u = Exogenous shifter such as consumption preferences and cost of substitute commodities.

Equation 3.2 $=\sum_{i=1}^{n} \pi_i + T$; the cash constraint states that expenditure by the household should not exceed profits and transfers from other sources of income.

π_i = Profits from vegetable sale

T = Other income

Equation 3.3 = $q_i - x_i - m_i - c_i$; the resource balance, states that, for each of the N goods, the quantity consumed, used as input and sold is equal to what is produced and bought

q_i = Amount to produce

x_i = Amount to use as input for the next season

m_i = Amount to sell

c_i = Amount to consume

Equation 3.4 $=G(q_i, x_i; z_q)$; relates input to output.

q_i = Amount to produce

x_i = Amount to use as input for the next season

z_q = Production shifters such as price of other inputs such as fertilizer and labour

As this study sought to show how different magnitudes of transaction cost influence farmer profits this framework should capture effect of these costs on farmers facing a variety of market imperfections. Several new institutional economics theories are essential in explaining how transaction costs are incurred due to market imperfections. Contract theory describes instances where a farmer enters into either an informal or formal agreement with a buyer to facilitate market exchange and thus reduce uncertainty. The theory of agency interactions showcases how power dynamics and human behaviour will influence the amount of transaction costs incurred by a farmer. For example a farmer with limited capacity to access urban markets will incur high transaction costs spending time negotiating with a broker at farm-gate for better prices. Similarly, theory of imperfect information shows that farmers will have to incur transaction costs as they search for market prevailing prices for vegetables. Thus, such instances of transaction cost incurrence were included in the cash constraint to show how farmer profit is affected. This led to Equation 3.2 being re-written as Equation 3.5.

Equation 3.5 = $\sum_{i=1}^{N}[(\pi_i - t_{pi}^{s}(Z_t^s))\delta_i^s]m_i - t_{fi}^{s}(Z_t^s)\delta_i^s + T$

π_i = Profits from vegetable sale

p_i = Selling price of each unit of vegetable

t_{pi}^{s} = The unobservable amount of proportional transaction costs such as time spent negotiating a contract.

Z_t^s = Observable characteristics of transaction costs such as direct expenditure incurred during negotiation or searching for prices.

δ_i^s = one if $m_i \geq 0$ if the household is a net producer and zero otherwise

m_i = Amount of vegetables to sell

t_{fi}^{s} = Fixed transaction costs incurred by household such as money spent searching for market prices or enforcing a contract.

3.3 Analytical Framework

In the presence of market barriers, farmers may either remain subsistence or choose to participate in various markets based on their individual characteristics, resource capacity and the existing institutional environment (Escobal & Cavero, 2012). In SSA it is expected that not all smallholder farmers will sell their produce in profitable urban markets due to numerous market barriers (Alene *et al*., 2008). If such a scenario is modelled, the expectation is that most farmers will tally zero showing non-participation in urban markets. However, within this study, non-participating households were purposefully excluded from the sample as transaction costs would be unobservable. This systematic exclusion increases likelihood of sample selection bias (Reyes et al., 2012).

In modeling market participation, the double hurdle method (Ricker-Gilbert et al., 2011) has been used as it is suitable to capture the value of zero indicating non-participation as a valid economic choice. Similarly, the Tobit model has been used to analyze market supply (Bellamere & Barrett, 2006). However, a disadvantage of the Tobit model is that it assumes the same set of parameters and variables determine both the probability of market participation and intensity of market participation (Reyes *et al*., 2012). Because this study expected that transaction costs variables that affect probability of participation in a particular market not to affect profitability in the same manner, the Tobit model was not the best-fit. On the other hand, the Heckman model (Heckman, 1979) does not have this limitation (Alene *et al*., 2008) and as sample selection bias is expected, it is the preferred alternative as it accounts for this bias, unlike other variations.

The first stage of the Heckman method used the probit equation to determine probability of participating in the vegetable supply chain. This was shown as 'selling directly in urban market' or by 'selling at farm-gate'. Those who sold directly in urban markets were hypothesized to incur higher transaction costs because they access more profitable markets compared to the other group. The Inverse Mills Ratio generated from this first stage to cater for any selection bias due to non-randomization of sample selection was introduced in the second step Ordinary Least Square (OLS) regression to explain effects of magnitude of transaction costs on profitability. A probit model of choice of market channel in the vegetable supply chain was given as equation 3.6:

$$\text{Prob}\ (MCC_i=1|x_i,\beta\ ) = \emptyset'(F(\beta_1x_1+\beta_2x_2+\beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6+\beta_7x_7+\beta_8x_8+\beta_9x_9+\beta_{10}x_{10}+\beta_{11}x_{11}+\beta_{12}x_{12}+\beta_{13}x_{13}+\beta_{14}x_{14}+\beta_{15}x_{15}+\beta_{16}x_{16}+\beta_{17}x_{17}))+\varepsilon_i,$$

$$\varepsilon_{i1}\sim N(0,\sigma_1^2)$$

Where:

MCC_i	=	Choice of institutional arrangement for household *i* (1=Selling directly in urban markets, 0=Selling at farm-gate)
$\emptyset'$	=	Standard normal cumulative distribution function
β_{17}^{1}	=	Parameters to be estimated for each explanatory variable
x_1	=	Sex of the respondent (1=Male, 0= Otherwise)
x_2	=	Age of the respondent
x_3	=	Land under vegetable to total farm size ratio
x_4	=	Land under vegetable production (In acres)
x_5	=	Total number of years in school
x_6	=	Farming experience in years
x_7	=	Interaction with other farmers (1=Yes, 0=Otherwise)
x_8	=	Information search indirect costs (Time spent in minutes)
x_9	=	Information search direct costs (Costs incurred in Kenya Shillings)
x_{10}	=	Negotiation indirect costs (Time spent in minutes)
x_{11}	=	Negotiation direct costs (Costs incurred in Kenya Shillings)
x_{12}	=	Monitoring transaction indirect costs (Time spent in minutes)
x_{13}	=	Monitoring transaction direct costs (Costs incurred in Kenya Shillings)
x_{14}	=	Do you sell through middlemen (1=Yes. 0= No)
x_{15}	=	Do you sell through market brokers (1=Yes, 0=No)

x_{16} = Mode of transport (1=Own, 0=Otherwise)

x_{17} = Nature of sales (1=Sales based on exact request, 0=Otherwise)

ε_i = Random error term with zero mean and unit variance

Subsequently, the second step of the model looked at effect of transaction costs on profitability of farmers conditional on them selling directly in urban markets. That is, those whose MCC_i value was 1; thus their profits could be observed.

The second step regression model of profitability was given as equation 3.7:

$$\text{PRFTS} = (\beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} + \beta_{15} x_{15} + \beta_{16} x_{16} + \beta_{17} x_{17}) + \rho_m \gamma_m + \varepsilon_{i2}$$

$$\varepsilon_{i2} \sim N(0, \sigma_2^2)$$

PRFTS was profits realized by a farmer. In this study, profits were expressed through proxy as gross margins a farmer gets monthly. This was calculated as the value resulting from subtracting variable costs from total farm income (Nemes, 2009). The explanatory variables remained as earlier defined in equation 3.6. γ_m is the inverse mills ratio based on $\gamma_m = \emptyset(\beta_1 x_1)/\emptyset'(\beta_1 x_1)$.where $\emptyset$ is the probability density function and $\emptyset'$ is the cumulative distribution function (Alene *et al*., 2008). ρ_m is the associated parameter to be estimated, and ε_{i2} is a random error term with zero mean and unit variance.

3.5 The Study Area

This study was conducted in Kiambu County which borders Nairobi County to the south, and provides it with most of its leafy vegetables; Kales, Spinach, Amaranth, African Nightshade, Spiderplant and Cowpea (Irungu, 2007 & Tschirley, 2008). Based on pre-survey market visits in the formal urban markets in Nairobi, Lari and Juja sub-counties were identified as study sites in Kiambu based on the high number of farmers and traders in the market who came from those two regions.

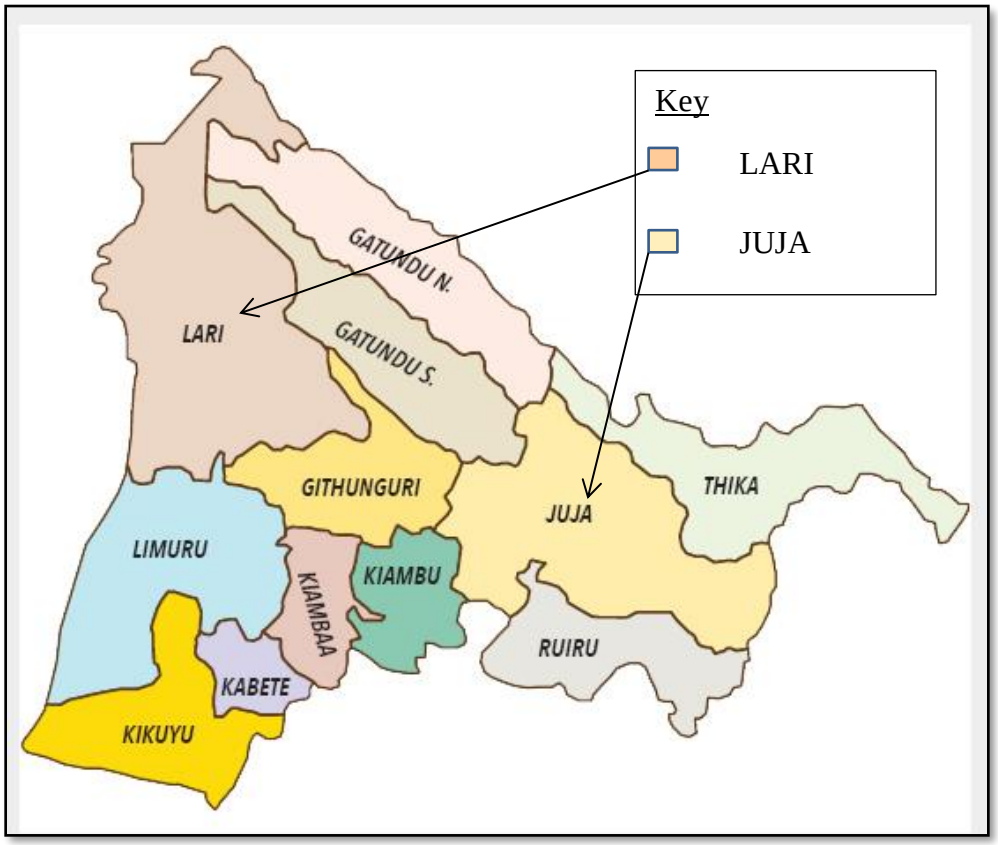

Figure 2: Map of Kiambu County[6]

[6] http://kiambu.go.ke/about-us/#7

With a total arable land of 1,878.4 Km^2 of which 21,447 Ha is under food crops, agriculture is the most predominant economic activity in Kiambu County and contributes 17.4 percent of the population income. This makes it the leading sub sector in terms of employment with 304,449 people directly or indirectly employed in the sector, food security, income earnings and overall contribution to the socio-economic well-being of the people in the county and the urban population in Nairobi (Tschirley, 2008).

3.5.1 Geographical, Climatic and Environmental Characteristics of Kiambu County

Kiambu County is divided into four broad topographical zones, Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The two study sites, Lari and Juja are found in the Upper Highland Zone (an altitude of 1,800-2,550 metres above sea level) and Upper Midland zone respectively (1,300-1,500 metres above sea level). Both these areas are conducive for vegetable production.

With regards to rainfall patterns, the county experiences a bi-modal rainfall season. The long rains are experienced between Mid-March to May and the short rains between Mid-October to November. Annual rainfall varies with altitude, with areas around Lari receiving as high as 2,000 mm and lower areas of Juja receiving as low as 600 mm. Mean temperature in the county is 26^{o}C with temperatures ranging from 7^{o}C in the upper highlands areas of Lari to 34^{0}C in the areas around Juja sub-county.

3.6 Sample Size and Sampling Procedures

The Cochran (1963) formula was used to determine the sample size. The formula is shown as:

$$n = \frac{z^2 pq}{e^2}$$

Where:

n= sample size

z^2= the abscissa of the normal curve that cuts off an area α at the tails (1-α equals the desired confidence level)

e = the desired level of precision

P = implies maximum possible variance

q= 1-p

The study desired a 95 percent confidence level and 5 percent precision level. As variation in vegetable commercialization among the farmer population was not widespread due to the high homogeneity with regards to vegetables cultivated and sold, P was 0.1. Thus, the samples size was calculated as:

$n = \frac{1.96^2(0.1)(0.9)}{(0.05)^2}$ = 138 respondents.

However, not all farmers contacted through the county extension office were available for interviews hence the number reduced to 111 farmers. The reasons provided for their absence were they had other impromptu engagements to attend while others were not willing to spend time being interviewed without monetary compensation.

The sampling frame for the household survey comprised of leafy vegetable farmers in the two sub-county study sites. Commercializing leafy vegetable farmers were purposively selected. Since the two sub-counties have varying population densities; Lari, 307 people·km^2, and Juja, 397 people·km^2, a proportional to size sample was used producing 48 respondents in Lari, and 63 in Juja. It is important to note that during data collection the main challenge was to ascertain the actual number of farmers in each study site in order to construct the sampling frame. This was because no formal database of leafy vegetable farmers was maintained in the sub-county agricultural office. Therefore, farmers were identified with help from sub-county agricultural extension officers. During data collection, respondents gathered at centrally agreed locations such as church halls and community halls which were easily accessible to the farmers to facilitate data gathering. In Lari, the specific interview sites were Nyamabari, Kijabe and Kinale. While in Juja, they were Kalimoni J, Kalimoni K and Kalimoni L.

3.7 Data analysis

3.7.2 Data types and sources

The study collected primary farmer household-level data for analysis. Primary data were collected using both focus group discussions and a semi-structured questionnaire at household level in the two regions. Qualitative data was sourced through focus group discussions. These data allowed characterization of institutional arrangements. Additionally, some questions in the data collection tool were categorized based on a thematic analysis to facilitate characterization. Resulting recurring themes were; knowledge of market prices through other farmers, being price takers, preference for selling through middlemen to reduce on costs incurred participating in markets and use of trust-based enforcement mechanisms were often mentioned.

To address the second study objective, the magnitudes of transaction costs in the leafy vegetable supply chain were measured using means of central tendency and inferential statistics using the Statistical Package for Social Sciences (SPSS) version 21. To allow this analysis, total transaction costs were disaggregated into direct transaction costs and indirect transaction costs. This classification was based on studies done by Mburu *et al*. (2003) and Irungu (2007) who measured these costs in their respective studies. Direct transaction costs were calculated based on money directly spent by individual households to access price information, search for markets, enter into both formal and informal contracts and subsequent monitoring of these contracts. Likewise, the indirect transaction costs were a product of profit accrued from the vegetable enterprises per minute[7] multiplied by every minute spent on searching for price information, contracting, negotiation and bargaining and monitoring contracts on a monthly basis.

The Heckman model equations were estimated using STATA version 14 to assess the probability of choosing a preferred institutional arrangement given the varying magnitudes of transaction cost and the effect of these costs on farmer profitability.

3.8 Definition of variables used in the Heckman Model.

The hypothesized relationships between the independent and dependent variables are based on the conceptual framework (Figure 1). This study hypothesized that level of farmer interaction, '*Socap*', as a measure of their social networks may either have a positive or negative relationship with market participation and subsequently profits. Farmers are socially embedded economic agents (Dorward *et al*., 2009). Therefore, they will interact with each other when searching for market intelligence to facilitate their decision making processes. A pervasive side of social capital

[7] Minutes were the most used unit of time by respondents when expressing their indirect transaction costs.

is seen from Jagwe and Machethe (2011). They observed that farmers in Central Africa were less likely to sell in markets due to influence from neighbor farmers and other traders. They argued as these farmers primarily rely on information from their counterparts, they can easily be misled and discouraged not to participate in markets; to the advantage of the other farmer who therefore maintains a large market share. This subsequently influences amount of profits they record. Mburu and Wale (2006) showed a less opportunistic side of farmers where they attributed their high levels of homogeneity as a strong influence on coming together to sell their produce in the urban markets that were considered profitable.

Experience, measured as the variable '*Exp'*, has been related to improved farmer ability in understanding market behavior and improved negotiation for better prices and higher profits (Matungul *et al*., 2001; Huo, 2015). This study therefore hypothesized that a positive relationship exists between this variable and both sets of dependent variables.

The variable age has been hypothesized to have either a negative or positive influence on farmer profits and market participation. This study based this narrative on an older farmer being less inclined to participate in various challenging tasks involved in selling vegetables in urban markets as shown by Oguoma *et al*. (2010). Further Huo (2015), found a similar relationship where age had a negative influence on farmers selling their produce directly to distant urban markets and instead preferred using brokers at farm-gate. Farmers not selling directly in urban market has a high opportunity cost versus selling through intermediaries who offer lower prices (Rao, 2008). However, cases existed where a farmer's age had a positive influence with their market participation and subsequently profits (Fischer & Qaim, 2012).

Table 1: Description of variables used in the Heckman model

Independent Variables	Definition	Market participation	Profitability
Sex(1=Male, 0=Otherwise)	Sex of the respondent	+	-
Age	Age of the respondent	+/-	+/-
VgLndFm	Land under vegetable to total farm size ration	+	+
Edu	Total number of years in school	+/-	+/-
Exp	Farming experience in years	-	+
Socap (1=yes; 0=Otherwise)	Interaction with other farmers	+/-	+/-
InfoIn	Information search indirect costs	-	-
InfoDi	Information search direct costs	-	-
NegIn	Negotiation indirect costs	+	+
NegDi	Negotiation direct costs	+	+
MonIn	Monitoring transaction indirect costs	+	+
MonDi	Monitoring transaction direct costs	+	+
Midd (1=yes; 0=Otherwise)	Do you sell through middlemen	-	-
Brok (1=yes; 0=Otherwise)	Do you sell through market brokers	+	+
MOT (1=Own; 0=Otherwise)	Mode of transport	+	+
SaleRi (1=sales based on exact request; 0=Otherwise)	Nature of sales	-	-

Sex of the farmer was captured as a dummy variable showed as either male or female. Studies have hypothesized that either sex has varying influence in market participation and intensity of participation that results in profitability (Reyes *et al*., 2012). Omiti *et al*. (2009) when conducting a study on kales in Kenya found that male households were more likely to have a higher degree of intensity in market participation than female led households. This study therefore hypothesized that a positive relationship between sex and probability of selling in urban markets and profitability existed.

Ratio of land under leafy vegetable production to total farm size, measured as the variable '*VgLndFm'* was expected to have a positive influence on urban market participation and profitability. Studies have found a positive relationship between size of land under crop production and market participation only; while others found size influencing intensity of participation (Komarek, 2010; Jagwe & Machethe, 2011).

The variable '*Edu*' measuring the total number of years a respondent was in school was hypothesized to have either a positive or negative relationship with both market participation and profitability. Ouma *et al*. (2010) found that household head level of education had a negative relationship with urban market participation. However, Lubungu *et al*. (2012) and Mmbando (2014) found that level of education has a positive effect with choice of selling to urban markets as respondents are assumed to have better ability to understand market dynamics. Likewise, Boughton *et al*. (2007) found level of farmer education to be positively related to intensity of market participation thus profitability.

Transaction costs are expected to have both a positive and negative relationship with market participation and profitability. This hypothesis is based on the numerous barriers that prevent farmers from actively participating in markets and the Coasian assumption that market participation is not costless (Sadoulet & de Janvry, 1995). Omiti *et al*. (2009) used distance to markets as a proxy for transaction costs and showed that the further away a farmer was from the market, the higher the transaction costs would be as they strived to access and participate in that particular market. In this study, transaction costs were measured empirically based on six distinct forms of these costs as observed in agricultural markets (Kyeyamwa *et al*., 2008, Dorward *et al*., 2009). These were; the variables '*InfoIn*' and '*InfoD*i' as a measure of indirect transaction costs and direct transaction costs related to searching for market information respectively. The third

and fourth variables were '*NegIn*' and '*NegDi*' as a measure of indirect transaction costs and direct transaction costs related to negotiation between a farmer and another chain actor respectively. The fifth and sixth variables were '*MonIn*' and '*MonDi*' as a measure of indirect transaction costs and direct transaction costs related to monitoring the transaction with another chain actor and other markets for better prices or institutions such as grades and standards therein respectively.

This study included other variables to measure transaction costs as proxy variables. Selling vegetables through middlemen as represented in the model by the variable '*Midd*' is hypothesized to have a negative influence on market participation and profitability. This assumption is guided by Gabre-Madhin (2001) who did a study on the role of intermediaries in the grain market of Ethiopia. The author found a positive relationship between use of grain intermediaries and market participation among the farmers. Further, Oguoma *et al*. (2010) showed that due to the high risks in the agricultural supply chain in SSA, farmers preferred to use intermediaries than sell directly at urban markets. However, they were mainly price takers and thus exposed to exploitative tendencies from these intermediaries and this reduced their expected profit margins.

Selling through urban market brokers was also included as the proxy variable '*Brok*' to measure transaction costs associated with incentive and supervision costs (Sadoulet & de Janvry, 1995). This is because market brokers are expected to have an established customer base in their respective urban market hence a farmer will have reduced risk in identifying potential buyers (Oguoma *et al*., 2010). This variable was hypothesized to have a positive relationship with both dependent variables.

Mode of transport has been used as an observable factor that mitigates transaction costs when a farmer has ownership of the transportation asset (Moono, 2015). However, where the farmer has to hire transport and the market is far, a negative relationship between the mode of transport and market participation and intensity of participation has been recorded (Alene *et al*., 2008). This study used the variable '*MOT*' to identify the mode of transport used by the respondent. This variable was hypothesized to have a positive relationship with market participation and profitability.

The variable '*SaleRi*' was used to understand the nature of market information a respondent received and thus influenced the nature of their sales. Theoretical underpinnings of SSA markets describe them as; being thin, having imperfect information and uncertainty (Kirsten *et al*., 2009). For this reason, this dummy variable (1= Sales based on exact requests, 0= Otherwise) is postulated to have a negative relationship with profitability and market participation. This is because farmers selling vegetables in urban markets based on exact requests capture an ideal environment where risks of transaction failure are low and market information is perfect among traders and farmers. Thus, this study hypothesizes such an environment to be rare based on the SSA market narrative.

3.9 Diagnostic Tests

3.9.1 Multicollinearity

Multicollinearity is observed in a dataset where the variables being regressed are highly correlated. This problem often results to highly inflated standard errors of coefficients thus larger confidence intervals. As a consequence, a study may fail to reject the null hypothesis (Gujarati, 2007). In this study, the Variance Inflated Factor (VIF) and Pearson Pairwise correlation matrix were conducted to test for this multicollinearity problem. The VIF shows how much the variance of an estimator has been inflated due to the presence of multicollinearity.

Absence of multicollinearity is indicated by VIF equaling 1 and the presence of it has VIF approaching infinity (Gujarati, 2007). According to Alauddin and Ngheim (2010) a VIF that is less than 5 indicates absence of multicollinearity. For this study, the VIF for all the independent variables is provided in Appendix 1. Additionally, a Pearson Pairwise correlation matrix was conducted on the independent variables (Appendix 2) from STATA 14. According to Gujarati (2007), if the pair-wise correlation is in excess of 0.8, then the data have a serious problem of multicollinearity.

3.9.2 Heteroscedasticity

Heteroscedasticity refers to the absence of constant variance of each error term conditional on the selected value of the independent variables. If error terms of the explanatory variables are considered to have heteroscedasticity, the estimates will not be the Best Linear Unbiased Estimates (BLUE) (Gujarati, 2007). For this study, the data was tested for heteroscedasticity using the Breusch-Pagan test (Wooldridge, 2009).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Demographic and Socio-economic Characteristics of the Sample

The average age of the two groups of farmers selling through different market arrangements was not statistically different (Table 2). Majority of the farmers selling directly to urban markets were male (72 percent). It is likely that female farmers face relatively more severe time constraints given their many household chores (Quisumbing *et al*., 2014).

The farmers who sold in the urban markets had on average larger farms and the proportion of the farm area occupied by vegetables was also larger. This difference between the groups was significant at the 95 percent level. These results are consistent with the idea that those selling at the urban markets are more market oriented and therefore actively seek better prices than their counterparts.

The level of social capital was quite high among both groups of farmers. Respondents who sold directly at urban markets, (72 percent) asserted to have influenced other farmers to join the vegetable selling enterprise. This assertion was also true for respondents who sold at farm-gate, (80 percent). Despite this observation on social capital not being statistically significant, it is quite intuitive as this high homogeneity was found to play an essential role in the maintenance of the market arrangements as farmers especially those who sell at farm-gate would enquire on market prices from their fellow farmers. This would provide them a basis for negotiation with middlemen.

Table 2: Summary characteristics of socio-economic variables

Variable	Urban market (n=36) Mean	Farm-gate (n=75) Mean	t-test
Age of farmer in years	47.22	43.97	1.312
Experience selling vegetables (Years)	12.33	12.48	0.074
Vegetable farm to total farm size ratio	0.7	0.6	1.652*
Maximum number of years in school	10.2	10.8	-0.884
			Chi^2
Sex (1=Male, 0=Otherwise)	72.2 percent	62.7 percent	0.908
Interaction with other farmers (1=Yes, 0=No)	72.2 percent	80 percent	0.843

Source: Own survey results (2017); ***p<0.01, **p<0.05,*p<0.1, respectively.

4.2 Characteristics of Institutional Arrangements in the Leafy Vegetable Supply Chain based on Focus Group Discussions

Selling at farm-gate had prices as the primary coordinating mechanism. This is because there are no other prior engagements between traders and producers with regards to vegetable quality, producers were not under any obligation to commit to any investment that would ensure they sell under this arrangement and there were no formal documents that were used or associated with the market relationships between the producers and intermediaries. Furthermore, due to the absence of costless third-party enforcement mechanisms, farmers preferred to trade with brokers whom they had prior transactions with or those with whom other farmers had transacted with. In such cases, trust based enforcement or reputation based enforcement were the most observable forms of transaction enforcement. Therefore, in this channel, it could be considered wholly based

on the characteristics of its institutional arrangement that transaction costs incurred by farmers were much lower. Rural farmers face two major transaction risks, coordination and opportunism (Poulton *et al*., 2006). In this study, when looking at coordination risks, leafy vegetable farmer selling at farm-gate were not required by buyers to have any complimentary investment to facilitate exchange. Therefore, transaction costs associated with supervision costs against this risk were low. Nonetheless, farmers had to do initial screening of brokers from neighbours in order to understand how trusted this broker is. In instances of high social capital among farmers information on cheaters or bad practices from brokers is easily transmitted across their social networks (Kirsten *et al*., 2009). This screening generated transaction costs through searching for information. Nevertheless, depending on the credibility of information gathered with regards to trustworthiness and reliability of a broker, and a broker's need to maintain good reputation with the farmers, costs relating to enforcement were not observed. Similarly, as this arrangement did not have any observed presence of a public-benefit institution that provided reliable market information on vegetable prices, farmers who sought to maximize their utility from these exchanges had to incur costs bargaining for better prices in order to increase their profit margins. This is because the alternative to this 'missing' public-benefit institution such as government, which would provide prices was the brokers who essentially became the price makers due to the power asymmetry that favoured them.

Institutional arrangements for farmers who sold at the urban markets had different characteristics. Since these farmers sold their vegetables in the formal gazetted markets in Nairobi, their transactions were governed not only by prevailing prices, but also County market formal rules such as time of operations, access fee, and informal, adhoc rules made by brokers and market traders. Farmers in urban markets could only sell their leafy vegetable through contracting the

services of an urban market broker. This arrangement assured the farmer of attracting the broker's recurrent urban clients, and the broker would buy off all unsold leafy vegetables from the farmer albeit at a cheaper cost than the prevailing market cost when the market shuts down at noon. The other governance structure was constituted by urban market retail vegetable traders. These traders barred rural wholesale leafy vegetable farmers from selling their produce to urban clients who are not buying vegetables in bulk. This rule thus allowed the urban retailers to sell leafy vegetables to all urban retail clients.

Based on transaction cost theory, one principal source of inefficiency is the existence of actions not subject to contractual provisions due to the incomplete nature of contracts. In this arrangement farmers were not subject to any urban markets grades and standards that were placed by market authorities. This generated a broad margin of risk for these producers with regards to whether or not their leafy vegetables would attract buyers. They therefore incurred transaction costs by choosing to sell through brokers as earlier mentioned as this assured them of buyers. On the other hand, based on the incentive theory framework, more inefficiency in an institutional arrangement occurs due to missing contractual clauses. This as shall be observed in the following sections led to farmers participating in urban markets incurring high search costs for market intelligence to avoid them having any incentive problem if they deliver poor quality produce in an urban market as there was no mechanisms designed to guide on quality specifications.

Enforcement mechanisms in this latter arrangement involved market fines and sanctions from market participation by other traders or county market officials. However, among the respondents who use this arrangement, none of them answered in the affirmative to having had any enforcement mechanism applied on them. Thus this cost could not be observed. One of the reasons why this enforcement mechanism seemed effective was because of the supervisory role of

elected market traders who would monitor exchanges to ensure no opportunistic behaviors came up and second, the loss of revenue that would result if one was found breaking the rules.

4.3 Magnitude of Transaction Costs of Producers in the Leafy Vegetable Supply Chain

The means of total transaction costs incurred by the two groups of farmers were statistically different (Table 3). Farmers who sold vegetables at the urban market incurred more transaction costs. This may be due to their need to surmount barriers related to price information and market access along this market channel, and contractual arrangements with transporters and urban market brokers. This argument is supported by higher, significantly different, direct transaction costs of this group in searching for information and contract negotiation.

The high direct cost for searching for market information signifies the size of a barrier these costs represent for smallholder vegetable farmers. This situation also occurs in other SSA countries (Mmbando, 2014) where high transaction costs imply imperfect knowledge of market opportunities, and together with information asymmetry, leads to increased cost of gathering information. This may provide an explanation why some vegetable farmers choose the less costly option of selling at the farm-gate (Jagwe et al., 2010).

Another significant difference was for costs incurred in contract negotiation. Agricultural contracts are essential in reducing production and marketing risks (Kherralah and Kirsten, 2002). This is through agreement of specific quality requirements with various intermediaries in the supply chain, and ensuring farmers have an immediate market outlet for their produce. Intermediaries can be exploitative, especially where farmers are highly dependent on them as their final buyer, which reduces the farmer's bargaining power (Mburu and Wale, 2006). Where intermediaries absorb a large portion of market risk they are more likely to impose low buying prices on farmers (Oguoma et al., 2010). Some costs intermediaries incur include transportation,

assembling, inventory management and storage. Contract negotiations, where intermediaries want to buy at low prices and farmers seek higher selling prices incur significant transaction costs as farmers may have to call various intermediaries to get better offers. Farmers who sell at urban markets, and not farmgate, may have to negotiate with various actors along the chain to access urban markets and participate, incurring transaction costs.

Farmers who sold at farmgate spend more time searching for information on market prices so they can negotiate with middlemen. This would ideally involve them calling or visiting neighboring farmers based on distance apart to determine prevailing prices and different contacts for middlemen who may pay better for leafy vegetables. Apart from incurring airtime costs, they minimize direct costs incurred through searching for market and price information by leveraging social capital and number of farmers or traders they had to call to gain this information.

The higher values in direct and indirect transaction costs in a farmer-urban market arrangement, can be related to inadequate physical infrastructure that farmers who participate directly in urban markets face when traveling to these markets (Kirsten et al., 2009). Inadequate physical infrastructures, such as all-weather roads leads to higher transportation charges from service providers especially during rainy seasons and more time spent by farmers trying to find cheaper providers and negotiate favorable transport fees.

Another form of direct transaction costs among farmers who take vegetables directly to central markets is incorporated in costs of contracting and negotiation for market access and participation with urban market traders. This group of farmers incurred these costs primarily due to presence of central market brokers. This particular institution of brokerage established rules acting as barriers to market entry. Farmers cannot sell produce directly in the central market without assistance of a broker to whom they enter into an informal contract. Under this contractual

arrangement, the farmer is obliged to pay a fee to the broker who then sells vegetables in the market on the farmer's behalf.

High indirect costs among farmers who sell directly at urban markets could be attributed to glut as the central markets receive vegetables from other locations. In order to ensure sales and profits margins are not affected, this group of farmers incurs transaction costs spending time searching for other markets to serve as alternative outlets for their produce.

Table 3: Direct, Indirect and Total Transaction Costs (in KES) in the two marketing arrangements

	Urban market (n=36)	Farm-gate (n=75)	
Cause of Transaction Cost	Mean	Mean	t-test
Direct transaction costs			
Search for market and price information	2254.58	383.13	-2.240**
Contract negotiation	2876.39	293.07	-3.276***
Monitoring transaction	656.67	138.8	2.417***
Indirect transaction costs			
Search for market and price information	4349.72	1701.96	-0.853
Contract negotiation	1498.91	11.43	-1.004
Monitoring transactions	267.96	48.14	2.671***
Total transaction costs (in KES) associated with the participation in the two marketing channels			
Total direct transaction costs	5787.64	815	-4.021**
Total indirect transaction costs	6116.59	1761.53	-1.121
Total transaction costs	11904.23	2576.53	-2.040**

Source: Own survey results (2017); ***p<0.01, **p<0.05,*p<0.1, respectively.

4.3. Results for Diagnostic Tests

For this two-step estimation, the variable coefficients were not jointly equal to zero as the Wald test of hypothesis that counters the above postulation was rejected at the one percent significance level.

The VIF was 1.33 indicating absence of multicollinearity. Nevertheless, the pairwise correlation test led to the removal of three transaction costs related variables from the model as they were above the 0.5 threshold.

With regards to the test for heteroscedasticity, the Chi-square value from the Breusch-Pagan test was 17.63 (p=0.02). The study therefore rejected the null hypothesis (of a constant variance). Thus, to deal with this issue of heteroscedasticity in the dataset, the regression was estimated using robust standard errors (Gujarati, 2007).

The inverse mills ratio was statistically significant at the 90 percent level. This shows that the problem of sample selection bias was encountered in this data set.

4.3.1 Effects of Transaction Costs on Choice to Participate in a Market Arrangement in the Supply Chain

Assessing influence of transaction cost on choice of market arrangement (Table 4) involved disaggregating these costs into direct and indirect information costs, negotiation costs and monitoring costs. However, due to high correlation among some of these transaction costs variables, only indirect costs of searching for information, monitoring and directs costs involved in negotiation were included.

Indirect costs associated with searching for information had a significant, negative, association with market channel choice. Farmers would prefer to sell from the farm gate to avoid spending time searching for market information and prevailing market prices (Mmbando, 2014).

Further, indirect costs associated with monitoring transactions had a significant, positive, association with market arrangement. This meant that the time spent monitoring the viability of a transaction would increase if a respondent chose to sell directly in the urban market. This finding may be due to a high number of intermediaries the respondent has to conduct business activities with across the supply chain. Kyeyamwa *et al*. (2008) found a similar finding with livestock farmers in Uganda whose supervision costs were high if they chose to sell their cattle at the main markets as they wanted to ensure other traders did not exploit them.

Direct costs from contractual negotiations also had a statistically significant positive effect on choice of market arrangement. The more direct costs incurred negotiating contracts along the supply chain, the higher the farmer's probability of directly selling vegetables at the urban market. This observation when coupled with the qualitative description of the institutional arrangement associated with this channel showed that farmers would more likely have to engage in contracts with transporters for those who did not own their own vehicles and market brokers.

In order to observe the effect of aggregated transaction costs, this variable was introduced in lieu of the three aforementioned variables and included the other three[8] that were removed due to multicollinearity problems. This total transaction cost variable had a significant positive association with directly selling in the urban markets at the 5 percent confidence level. This meant that increase in transaction costs would ideally be a response to a vegetable farmers' need to sell

[8] Direct costs associated with searching for information, direct costs associated with monitoring the transactions and indirect costs associated with negotiation of contracts with other actors.

their produce directly in urban markets. This positive relationship agrees with the findings of Jagwe and Machethe (2011) who using distance to market to capture transaction costs, found that banana farmers were willing to incur more costs and spend more time travelling to the markets due to the urgent need for higher cash revenue than sell at farm-gate to middlemen. The probit estimation of the Heckman model with this variable has been included in Appendix 3.

Using market brokers had a statistically significant positive association with selling in urban markets. This finding meant that farmers who sold directly at urban markets preferred selling through market brokers. This can be related to the institutional environment of this market arrangement as shown from Figure 1. Farmers preferred these brokers as they had their own clients in their respective markets and using them increased their chances of earning more. Further, the marginal effects of this variable indicated that selling through market brokers increased the probability of selling directly to markets by 21 percent holding all other factors constant.

Nature of sales based on buyer information had a significant negative association with market channel choice participation. A farmer who sold vegetables based on exact buyer requests had a higher probability of selling leafy vegetables at farmgate than directly from urban markets. Further, the marginal effects of this variable indicated that selling vegetables based on exact requests reduced the likelihood of selling directly to markets by 35 percent holding all other factors constant.

Using middlemen to sell vegetables had a negative association with choice of market channel. Farmers who used middlemen to sell their leafy vegetables preferred not to travel directly to the urban markets. The marginal effect of this variable indicated that the presence of middlemen reduced the probability of selling directly in urban markets by 44 percent holding all other factors

constant. This may be related to the risk-averse nature of some farmers who would prefer not to incur costs selling in distant markets. Perceptions among farmers, where existence of intermediaries is viewed as a beneficial market arrangement that overcomes problems of transaction costs and imperfect information has been observed in other parts of SSA (Jagwe and Machethe, 2011).

4.3.2 Effects of other Factors on Choice to Participate in a Market Arrangement in the Supply Chain

Age of the farmer had a significant positive relationship with the dependent variable. The positive relationship shows that older farmers would prefer selling directly to urban markets than from farm-gate which agrees with Jagwe and Machethe (2011). They attributed this result to older farmers having better negotiating skills. Similar findings by Makhura (2001) showed that older farmers in South Africa were more likely to sell horticulture produce directly in urban markets and argued that this was because they had accumulated knowledge on these markets.

Gebremedhin *et al*. (2009) found that farm size is essential in prompting smallholder market participation. In this study, the ratio of land under vegetable production to total farm size had a significantly positive association with selling directly in urban markets at the 5 percent confidence level. Further, the marginal effects indicated that a unit increase in this ratio would increase the probability of selling vegetables in urban markets by 44 percent. Mmbando (2014) found similar results among maize farmers in Tanzania whereby the larger the farm size, the higher the likelihood a household would have surplus production and thus participate in distant markets.

Education had a significant, negative, association with choosing to sell directly at urban markets. This could be explained due to highly educated respondents having other non-farm forms of employment and they did not have time to interact, negotiate with various actors and sell vegetables from urban markets.

Table 4: Factors influencing choice of leafy vegetable market arrangement

Dep. Var =MCC(1= Farmer selling to urban market, 0=otherwise)					
Independent Variables	Coef.	Std. Err	z	P>z	dy/dx
Constant	-2.76	1.30	-2.13**	0.033	
Sex	-0.12	0.48	-0.25	0.805	-0.05885
Age	0.05	0.02	2.33**	0.02	0.009548
Total number of years in school	-0.01	0.00	-1.72*	0.086	-0.00135
Experience selling vegetables	-0.001	0	-1.59	0.112	-0.00036
Use of middlemen	-1.25	0.50	-2.52**	0.012	-0.44322
Interaction with other farmers	-0.27	0.51	-0.53	0.597	-0.12458
Information indirect cost	-3.3E-05	1.57E-05	-2.10**	0.036	-1.00E-05
Monitoring indirect cost	0.004	0.00	2.68***	0.007	0.001124
Negotiation direct cost	0.000355	0.00	3.51***	0.000	0.000106
Mode of transport	-0.73	0.65	-1.12	0.264	-0.18194
Nature of sales	-1.98	0.79	-2.52**	0.012	-0.3564
Vegetable farm size to total farm size	1.62	0.81	2.00**	0.046	0.443758
Use of market brokers	0.76	0.43	1.77*	0.077	0.211767
Number of obs = 111					
Pseudo R^2 = 0.5250					
Wald Chi^2 = 108.20***					

Source: Own survey results (2017); ***p<0.01, **p<0.05,*p<0.1, respectively.

4.3.3 Effects of Transaction Costs on Vegetable Farmer Profitability in the Leafy Vegetable Supply Chain

From the second step OLS regression of the Heckman Model (Table 5), five variables including the Inverse Mills Ratio had significant relationships with farmer profitability.

For variables associated with transaction costs, time spent searching for information had a significant, positive, association with profitability. This indicates farmers who sold directly in urban markets, and spent considerable time finding reliable actors to transact with, and avoid opportunistic behavior, would have a high likelihood of increasing profitability. Effective institutional environments and arrangements are best suited to reduce transaction costs and risks (Zanello *et al*., 2012). This means an appropriate institutional mechanism is necessary to replace the time consuming process spent in searching for information by ensuring perfect market information reaches farmers. In such a scenario, leafy vegetable farmers would be expected to incur minimal transaction costs of this type as they endeavor to reduce risks and maximize utility. Contract negotiation and monitoring, albeit positive, did not have a significant relationship with profitability for participants in this channel.

4.3.4 Effects of Other Factors on Vegetable Farmer Profitability in the Leafy Vegetable Supply Chain

Ownership of an asset is an essential step in improving household income and welfare (Carter and Barrett, 2006). Ownership of a transportation asset, or ability to hire one, had a positive, significant, association with increasing profitability for farmers selling directly at urban markets. Ownership of bicycles, or motorized vehicles, increased the likelihood of market participation and higher revenue conditional on farmer participation (Boughton et al., 2007).

The vegetable farm size to total farm size ratio had a positive, significant, association with farmer profitability. Land holdings of farmers positively influenced their intensity of market supply (Alene *et al*., 2008; Mmbando, 2014; Moono, 2015). Increased land holdings resulted in increased production surplus and quantity sold. With other conditions being constant, these farmers had higher profit margins with increase in sale volumes.

There was a significant, positive, association between frequency of interactions among farmers selling in urban markets and increase in profitability. Social capital among farmers is an essential pathway to improved livelihood (Markelova & Mwangi, 2010; Moono, 2015). Through sharing of mode of transportation and market information; farmers assist each other in reducing uncertainty of market exchange, cost of market access, and participation allowing for improved profit.

Table 5: Factors affecting leafy vegetable farmer profitability

Ln. Profits n=36	Coef.	Std. Err.	z
Constant	10.24	1.35	9.53***
Sex	0.50	0.69	1.38
Age	0.006	0.20	0.52
Total number of years in school	-0.0008	0.00	-0.36
Vegetable farm size to total farm size ration	1.13	0.84	1.72*
Mode of transport	1.60	0.55	2.02**
Use of market brokers	-0.6	0.43	-1.05
Information time indirect cost	0.19	0.11	2.06**
Monitoring time indirect cost	0.1	0.20	1.31
Negotiation direct cost	0.19	0.12	0.35
Nature of sales	-1.79	0.72	-0.44
Interaction with other farmers	0.5	0.54	1.69*
Experience selling vegetables	0.002	0.01	0.43
Mills Ratio = -0.6572*			
Prob> Chi-Sq = 0.0000			
Log likelihood = -53.529172			

Source: Own survey results (2017); ***p<0.01, **p<0.05,*p<0.1, respectively.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusion

This study sought to determine the magnitudes of transaction costs of producers in the leafy vegetable supply chain, and assess the effects of these transaction costs on their choice of market arrangements and profitability. With regards to magnitudes of transaction costs, this study measured these costs based on its various components. These were cost and time spent searching for information, making contracts and enforcement of those contracts. The results showed that the monthly total transaction cost per vegetable producers selling directly to urban markets was KES 11,904.23 while those that sell through intermediaries incurred KES 2,576.53.

Additionally, the study found that transaction costs have an influence in not only the choice of the market arrangement but also on profitability. It was observed that time spent monitoring the transactions and costs associated with negotiation of a transaction had a positive influence on farmer choice to sell in urban markets. Time spent gathering information that should facilitate the transaction had a negative influence on farmer participation in an urban market. Other transaction cost related variables such as use of middlemen at the farm-gate had a negative effect to selling in urban markets. While others such as use of market brokers had a positive effect to selling in urban markets.

Other variables such as age, vegetable farm size to total farm size ration and use of urban market brokers all had a significant positive relationship with farmers choosing to sell in the urban market. Similarly, number of years in school, use of middlemen, and nature of sales risk all had a significant negative relationship with choosing to sell in the urban market.

With regards to profitability, the transaction cost variable, time spent searching for information had a positive influence on profitability. Other variable i.e. the mode of transport use, interaction with other farmers, and vegetable farm size to total farm size ration also had a significant positive relationship with profitability.

5.2 Recommendations

Considering the pervasive barrier of transaction costs as a negative consequence of imperfect markets, it follows that necessary policy recommendations should be suggested to assist the government and other stakeholders in charting a well-informed path towards better livelihoods across all ends of the leafy vegetable supply chain.

This study has identified the causes of transaction costs and as such advances that any measure to reduce them should have a specific recommendation on improving information reception and dissemination to farmers and from markets respectively. Therefore, improvements to the current soft infrastructure will facilitate dissemination of market and price information via text message-based services or through agricultural extension officers. This will allow farmers to be up to date with information on vegetable demand, prevailing market prices across both local and urban markets and vegetable packaging and market standards requirements and other essential variables that can help them reduce on their transaction risks.

Further, this study recommends that institutions that will minimize transaction costs related with negotiation and monitoring to be adopted by farmers. These institutions will facilitate linkages between farmers and profitable urban markets whilst minimizing the cost and time farmers initially spent negotiating and monitoring transaction with other actors. This recommendation is best suited where farmers have strong social capital.

Finally, this study recommends that the government should consider putting up strategies that not only facilitate stringent and faster processes of land ownership but also adequate size for agricultural purposes as well.

REFERENCES

Agrawal, A., and Gibson, C. (1999). Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation. *World Development*, 27(4), 629-649.

Alauddin, M. and Nghiem, H. (2010). Do Instructional Attributes Pose Multicollinearity Problems?: An Empirical Exploration. *Economic Analysis and Policy*: Vol. 40 No. 3, December 2010

Alene, A.D., Manyong, V.M., Omanya, G., Mignouma, H.D., Bokanga, M., and Odhiambo, G (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy,* 33: 318-328.

Alliance for a Green Revolution in Africa, AGRA, (2016). Africa Agriculture Status Report: Progress towards agriculture transformation in Sub-Saharan Africa. Nairobi, Kenya: *Alliance for a Green Revolution in Africa (AGRA)*. Issue No. 4.

Alliance for a Green Revolution in Africa, AGRA, (2017). Africa Agriculture Status Report: The Business of Smallholder Agriculture in Sub-Saharan Africa. Nairobi, Kenya: *Alliance for a Green Revolution in Africa (AGRA)*. Issue No. 5

Arrow, K. J. (1969). The organization of economic activity: Issues pertinent to the choice of market versus non-market allocation. In The analysis and evaluation of public expenditures: The PBB-system. *Joint Economic Committee, 91st Congress, first session*, Vol.1. Washington, D.C.: U.S. Government Printing Office.

Arrow, K.J. (1970). The organization of economic activity: issues pertinent to the choice of market versus non-market allocation, in Haveman, R.H and Margois, J (Eds), Public Expenditure and Policy Analysis, *Markham Publishing*, Chicago, IL, pp 59-71.

Azam, M.S., Imai. K, and Gaiha. R., (2012). Agricultural supply response and smallholders market participation: The case of Cambodia. *Economics Discussion Paper Series, No. 1208*. Manchester, UK: Economics Department, School of Social Sciences, University of Manchester.

Baland, J.M and Platteau, J.P. (1999). The Ambiguous Impact of Inequality on Local Resource Management. *World Development*, 27, (5), 773-788.

Banerjee, A and Duflo, E. (2011). Poor Economics: a radical rethinking of the way to fight global poverty. Published by *Public Affairs*, New York.

Barrett, C. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy*, 33(4), 299-317.

Bernard, T., and Spielman, D. (2009). Reaching the rural poor through rural producer organizations? A study of agricultural marketing cooperatives in Ethiopia. *Food Policy*, 34(1), 60-69.

Bienabe, E., Coronel, C., Le Coq, J.F. and Liagre, L. (2004). Linking smallholder farmers to markets: Lessons learned from literature review and analytical review of selected projects. *World Bank*, Washington D.C.

Birthal, P.S., P.K. Joshi and Ashok Gulati (2005). Vertical Coordination in High-Value Food Commodities: Implications for Smallholders, Markets, Trade and Institutions Division. *Discussion Paper No. 85, International Food Policy Research Institute*, Washington, D.C., U.S.A.

Bhattarai, S., Lyne, C.M., and Martin, K.S. (2013). Assessing the performance of a supply chain for organic vegetables from a smallholder perspective. *Journal of Agribusiness in Developing and Emerging Economies,* 3(2), 101-118.

Bjorndal, T., A. Lappo, M. Dey, A, Lem and A. Child. 2016. Economic analysis of food supply and demand in sub-Saharan Africa up to 2022. Fisheries and Aquaculture Circular No.1101, Rome, Italy.

Bonabana-Wabbi, J., Mogoka, H., Semalulu, O., Kirinya, J., & Mugonola, B. (2016). Adoption of integrated soil fertility management by groundnut farmers in Eastern Uganda. *Journal of Development and Agricultural Economics*, 8(4), 86-94.

Boughton, D., D. Mather, C.B. Barrett, R. Benfica, D. Abdula, D. Tschirley, and B. Cunguara. (2007). Market participation by rural households in a low-income country: An asset-based approach applied to Mozambique. *Faith and Economics*, 50:64-101.

Carter, M.R. and Barrett, C. B. (2006), The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach. *Journal of Development Studies*, 42(2): 178-1

Cadot,O., C.Carrère, J. de Melo and B. Tumurchudur) (2006). Product-Specific Rules of Origin in EU and US Preferential Trade Arrangements: an assessment. *World Trade Review*, Vol. 5(2): 199-224

Chilundika, N. (2011). Market Participation of Bean Smallholder Farmers in Zambia: A Gender Based Approach. *Department of Agricultural and Extension Education*, University of Zambia.

Chowdhury, S.K. (2002). Access to information, transaction costs and marketing choice of rural households between middlemen and direct buyers in Bangladesh. *Royal Economic Society Annual Conference*, University of Warwick, Coventry, UK, August 2002.

Coase, R.H. (1937). The Nature of the firm. *Economica* 4(16):386–405.

De Janvry, A., Fafchamps, M., Sadoulet, E., (1991). Peasant household behavior with missing markets: some paradoxes explained. *Econ*. J. 101, 1400-1417.

Deloitte & Touche, (2015). Reducing Food Loss along African Agricultural Value Chains. *Deloitte and Touche Group.*

Division of Nutrition and Dietetics, Ministry of Health, Kenya, (2015). Nutrition on the rise: Raising Kenya's future. Available at https://www.prb.org/wp-content/uploads/2015/08/kenya-malnutrition-factsheet.pdf (accessed 20th July 2018)

Dorward, A., Kirsten, J.F., Omamo, S.W., Poulton, C., and Vink, N., (2009). Institutions and the Agricultural Development Challenge in Africa, in Kirsten, JF., Dorward, A.R., Poulton, C., and Vink, N., Institutions Economics Perspectives on African Agricultural Development. *International Food Policy Research Institute*. pp 3-34.

Dorward, A. and Omamo, S.W., (2009). A framework for analyzing institutions, in Kirsten, JF., Dorward, A.R., Poulton, C., and Vink, N., Institutions Economics Perspectives on African Agricultural Development. *International Food Policy Research Institute*, Washington DC, USA, pp 135-184.

Driel, Hugo Van (2003). The role of middlemen in the international coffee trade since 1870: The Dutch case. *Business History*, Vol 45, No.2., (April, 2003), pp 77-101.

Eaton. D., Meijerink. G., Bijman, J., and Belt. J (2007). Analyzing the role of institutional arrangements: Vegetable value chains in East Africa, in Pro-poor development in low income countries: Food, agriculture, trade and environment 2007 proceedings of the 106th seminar of the *European Association of Agricultural Economists*, Montpellier, France, October 25th– 27th, 2007.

Eggerston, T. (1990). Economic Behavior and Institutions. *Cambridge University Press*.

Escobal, J. A., and Cavero, D., (2012). Transaction Costs, Institutional Arrangements and Inequality Outcomes: Potato Marketing by Small Producers in Rural Peru. *World Development, Elsevier,* vol. 40(2), pp 329-341.

Fafchamps, M. (2004). Market Institutions in Sub-Saharan Africa: Theory and Evidence. *Massachusetts Institute of Technology Press,* Cambridge, England.

Fafchamps, M and Hill, RV, (2005). Selling at farm-gate or travelling to market. *American Journal of Agricultural Economics* 8(3), 717–34.

Fischer, E., and Qaim, M. (2012). Linking Smallholders to Markets: Determinants and Impacts of Farmer Collective Action in Kenya. *World Development,* 40(6), 1255-1268.

Gabre-madhin, E.Z., (2001). Market institutions, transaction costs and social capital in the Ethiopian grain market. *International Food and Policy Research Institute,* Washington DC, USA.

Gebremedhin, B., M. Jaleta, and D. Hoekstra. (2009). Smallholders, institutional services, and commercial transformation in Ethiopia. *Agricultural Economics* 40:773-787.

Gebresenbet, G and Bosona, T. (2012). Logistics and Supply Chains in Agriculture and Food, in Groznik, A., and Xiong, Y., Pathways to Supply Chain Excellence. *IntechOpen*, DOI 10.5772/1783.

Government of Kenya. (2010). Agricultural Sector Development Strategy 2010-2020. GoK.

Grootaert, C. (1999). Social capital, household welfare and poverty in Indonesia. Local level institutions working paper No. 6. Washington, D.C: *The World Bank.*

Grover, V. and Malhotra, M.K., (2003). Transaction cost framework in operations and supply chain management research: theory and measurement. *Journal of Operations Management*, Vol 21, No.4, pp 457-473.

Gujarati N. D (2007). Basic Econometrics. *McGraw-Hill Companies*, *Inc*., New York, USA.

Heckman, J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*. 47: 153-161.

Hobbs, J.E. (1996). A transaction cost approach to supply chain management. *Supply Chain Management: An International Journal*, Vol. 1 Issue: 2, pp.15-27.

Hobbs, J.E. (1997). Measuring the importance of transaction costs in cattle marketing. *American Journal of Agricultural Economics*, 79(4):1083-1095.

Holloway, G., Nicholson, C., Delgado, C., Staal, S., Ehui, S. (2000). Agro-industrialization through institutional innovation: transaction costs, cooperatives and milk-market development in the east-African Highlands. *Agric. Econ* (23), 279-288.

Hudson, D., and Lusk, J., (2004). Risk and transaction cost in contracting: Results from a choice-based experiment. *Journal of Agricultural and Food Industrial Organization*, 2 (1), Article 2.

Huo, J.H.X., (2015). Transaction Costs and Farm-to-market linkages: Empirical Evidence from China Apple Producers in Agriculture in an interconnected world 2015 proceedings of the 29th *International Conference for Agricultural Economists conference* in Milano, Italy, 8-14th August, 2015.

Imungi J. K., (2002). The brighter side of phenolic compounds abundance in African leafy vegetables. *IPGRI Newsletter for sub-Saharan Africa*. Issue No. 17.

International Fund for Agricultural Development, IFAD (2001). Enabling the Rural Poor to Overcome Their Poverty. *Annual Report*, 2001.

International Fund for Agricultural Development, IFAD (2016). Rural Development Report: Fostering Inclusive Rural Transformation. ISBN 978-92-9072-682-1.

Irungu, C., (2007). Analyzing Markets for African Leafy Vegetables within Nairobi and its environs and implications for on-farm conservation of biodiversity. *Global Facilitation Unit for Underutilized Species*.

Jaffee, S.M., (1995). Transaction Costs, risks and the organization of private sector food commodity systems, in Jafee. S, and Morton, J (Eds), Marketing Africa's High Value Food: Comparative Experiences of an Emergent Private Sector. *Kendall/Hunt Publishing*, Dubuque, IA, pp. 21-62.

Jaffee, S., Siegel, P., and Andrews, C. (2010). Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework. *The World Bank,* Washington. D.C.

Jagwe, J., and Machethe, C (2011). Effects of transaction costs on choice of selling point: a case of smallholder banana growers in the Great Lakes Region of Central Africa. *Agrekon.*

Jagwe, J., Machethe, C, and Ouma, E. (2010). Transaction costs and smallholder farmers' participation in banana markets in the Great Lakes Region of Burundi, Rwanda and the Democratic Republic of Congo. *African Journal of Agricultural and Resource Economics*, Vol 6, No.1 , 302-317.

Jari, B., and Fraser, G.C.G. (2009). An analysis of institutional and technical factors influencing agricultural marketing amongst smallholder farmers in the Kat River Valley, Eastern Cape Province, South Africa. *African Journal of Agricultural Research,* 4(11):1129-1137.

Kaganzi, E., Ferris, S., Barham, J., Abenakyo, A., Sanginga, P., and Njuki, J. (2009). Sustaining linkages to high value markets through collective action in Uganda. *Food Policy*, 34(1), 23-30.

Key, N., and Runsten, D., (1999). Contract farming, smallholders and rural development in Latin America: The organization of agroprocessing firms and the scale of outgrower production. *World Development*, 27(2), 381-401.

Key, N, Sadoulet, E and de Janvry, A, (2000). Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics* 82(2), 245–259.

Kherallah, M. and Kirsten, J.F. (2002). The New Institutional Economics: Applications for Agricultural Policy Research in Developing Countries. *Agrekon,* Vol. 41, No. 2, pp111- 134.

Kirsten J. and Vink, N. (2005). The economics of institutions: theory and applications to African agriculture. Course study material; *Department of Agricultural Economics Extension and Rural Development*, University of Pretoria, Pretoria.

Kirsten, J.F., Mohammed. A.S.K., and Dorward, A., (2009). Introduction to the economics of institutions, in Kirsten, JF., Dorward, A.R., Poulton, C., and Vink, N., Institutions Economics Perspectives on African Agricultural Development. *International Food Policy Research Institute*. pp 3-34.

Klein, B., Crawford, R.G, and Alchian, A.A. (1978). Vertical Integration, Appropriable Rents, and the Competitive Contracting Process. *Journal of Law and Economics*, 21(2), pp. 297–326.

Komarek, A. (2010). The determinants of banana market commercialization in Western Uganda. *African Journal of Agricultural Research*, 5(9):775-784.

Kyeyamwa, H., Speelman, S., Van Huylenbroeck, G., Opuda-Asibo, J., and Verbeke, W. (2008). Raising offtake from cattle grazed on natural rangelands in sub-Saharan Africa: a transaction cost economics approach. *Agricultural Economics*, 39(1).

Kydd, J. (2002). Agriculture and Rural Livelihoods: Is Globalisation Opening or Blocking Paths Out of Rural Poverty? *Agricultural Research and Extension Network Paper* No. 121. ODI

Liverpool-tasie, L.S.O.O., Bolarin, T.S, Awa, O., Wale, O. (2017). Is increasing inorganic fertilizer use for maize production in SSA a profitable proposition? Evidence from Nigeria. *Food Policy*, Vol. 67, pp 41-51.

Lubungu, M., Chapota, A., Tembo, G., (2012). Smallholder farmers' participation in livestock Markets: Case study of Zambia. *Indaba for Agriculture Policy Research Institute*. Working Paper No. 66.

Makhura. M.T., (2001). Overcoming transaction cost barriers to market participation of smallholder farmers in the Northern province of South Africa. PhD thesis, *Department of Agricultural Economics, Extension and Rural Development*, University of Pretoria.

Manzini, R., and Accorsi, R. (2013). The new conceptual framework for food supply chain assessment. *Journal of Food Engineering*, 115(2), 251-263.

Markelova, H., and Mwangi, E. (2010). Collective Action for Smallholder Market Access: Evidence and Implications for Africa. *Review of Policy Research*, 27(5).

Markelova, H., Meinzen-Dick, R., Hellin, J., and Dorhn, S. (2009). Collective action for smallholder market access. *Food Policy*, 34 (1), 1- 7.

Masten, S.E. (2000). Transaction-cost economics and the organization of agricultural transactions. *Industrial Organization*, (9), 173-195.

Masuku, M.B., and Kirsten, J.F., (2003). The role of trust in the performance of supply chains: a dyad analysis of smallholder farmers and processing firms in the sugar industry in Swaziland. *Contributed paper in the 41st Annual conference of the Agricultural Economic Association of South Africa (AEASA)*, October 2-3, (2003), Pretoria, South Africa.

Mather, D., Boughton, D., and Jayne T.S., (2011). Smallholder Heterogeneity and Maize Market Participation in Southern and Eastern Africa: Implications for Investment Strategies to Increase Marketed Food Staple Supply. *MSU International Development*, Working Paper.

Maundu P. M., (1995). The status of traditional vegetable utilisation in Kenya. *Proceedings of the IPGRI International Workshop on Genetic Resources of traditional vegetables in Africa: Conservation and Use,* 29th –31st August 1995, Rome.

Matungul, P.M., Lyne. M.C, and Ortmann. G.F., (2001). Transaction costs and crop marketing in the communal areas of Impendle and Swayimana, KwaZulu–Natal. *Development Southern Africa* 18(3):347-363

Mburu. J., and Birner. R., (2002). Analyzing the Efficiency of Collaborative Wildlife Management: The Case of two Wildlife Sanctuaries in Kenya. *International Journal of Organization Theory and Behavior*. Vol. 5, No. 3 & 4 pp259-298.

Mburu, J., Birner, R., and Manfred, Z., (2003). Relative importance and determinants of landowners' transaction costs in collaborative wildlife management in Kenya: an empirical analysis. *Ecological Economics*, 45 (59-73).

Mburu. J and Wale. E, (2006). Local Organisations involved in the conservation of crop genetic resources : condition for their emergence and success in Ethiopia and Kenya. *Genetic Resource and Crop Evolution*, 53: 613-629.

McCulloch N, and Ota M (2002). Export horticulture and poverty in Kenya. *Institute of Development Studies, University of Sussex, Brighton*. Working Paper No. 174.

Minot, N., Kherallah, M., and Berry, P., (2000). Fertilizer market reform and the determinants of fertilizer use in Benin and Malawi. *Markets and Structural Studies Division Working Paper No.40, International Food and Policy Research Institute*, Washington DC, USA.

Mmbando, E.F., (2014). Market participation, channel choice and impacts on household welfare: the case of smallholder farmers in Tanzania PhD thesis. *School of Agricultural, Earth and Environmental Sciences College of Agriculture, Engineering and Science University of KwaZulu-Natal*, South Africa.

Moono, L., (2015). An analysis of factors influencing market participation among smallholder rice farmers in western province, Zambia. Master's Thesis, *Department of Agricultural Economics, University of Nairobi,* Kenya.

Morrison, J., Dorward, A., Kydd, J., Poulton, C. and Smith, L. (2000). Sustainable Livelihoods and New Institutional Economics. *DFID Sustainable Livelihoods Programme: Policies, Institutions and Processes*. Wye College.

Mutuma, S.P., Okello, J.J., Karanja, N.K., and Woomer, P.L. (2014). Smallholder farmers' use and profitability of legume inoculants in western Kenya. *African Crop Science Journal*, Vol. 22, No. 3, pp. 205 – 213.

Narayan, D., and Pritchett. L. (1999). Cents and sociability: Household income and social capital in rural Tanzania. *Economic Development and Cultural Change,* 47:871-897.

Nemes, N., (2009). Comparative analysis of organic and non-organic farming systems: A critical assessment of farm profitability. *Natural Resource and Environmental Department, Food and Agricultural Organization of the United Nations*, Rome, Italy.

Norton, G.W., Alwang, J and Masters W.A, (2006). The economics of agricultural development: World food systems and resource use. *Routledge*.

Oakley P. (1991). Projects with People: The Practice of Participation in Rural Development. *International Labour Office,* Geneva.

Oguoma. O.N., Nkwocha. V.I., and Ibeawuchi. I.I., (2010). Implications of middlemen in the supply chain of agricultural products. *Journal of Agriculture and Social Research*. Vol.10., No.2.

Olwande, J., and Mathenge, M. (2011). Market participation among the poor rural households in Kenya. *Tegemeo Institute of Agricultural Policy and Development*.

Omamo, S. (1998). Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya. *American Journal of Agricultural Economics*, 80(1), 116-123.

Omiti., J, Otieno., D, Nyanamba. T, and McCullough. E. (2009). Factors Influencing the intensity of market participation by smallholder farmers: a case study of rural and peri-urban areas of Kenya. *African Journal of Agriculture and Resource Economics*, Vol 3, No.1, 2009.

Ortmann, G.F., and King, R.P. (2010). Research on Agri-food supply chains in southern Africa involving small-scale farmers: current status and future possibilities. *AEASA*, Vol 49(4) 2010, pp 397-417.

Ostrom, E., R. Gardner, and J. Walker. (1994). Rules, games, and common-pool resources. Ann Arbor: *University of Michigan Press*.

Ouma, E., J. Jagwe, G. Obare, and S. Abele. (2010). Determinants of smallholder farmers' participation in banana markets in Central Africa: the role of transaction costs. *Agricultural Economics* 41(1):111-122.

Peterson, M. (1999). The Role of Institutional Research: From Improvement to Redesign. *New Directions for Institutional Research*, 1999(104), 83-103.

Porter, M. E. (1985). Competitive Advantage: Creating and Sustaining Superior performances. *New York: Free Press*.

Poulton, C., Dorward, A., Kydd, J. (2005). The future of small farms: New directions for services, institutions and intermediation. Paper presented at *The Future of Small Farms workshop, 26-29th June 2005. Imperial College*, Wye, UK.

Poulton, C., Kydd, J., and Dorward, A., (2006). Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development Policy Review* (2006), 24 (3): 243-277.

Poulton, C. and Lyne, M.C., (2009). Coordination for market development, in Kirsten, JF., Dorward, A.R., Poulton, C., Vink, N., Institutions Economics Perspectives on African Agricultural Development. *International Food Policy Research Institute, Washington DC*, pp 135-184.

Quisumbing, A.R ., Meinzen-Dick, R., Raney, T.L., Croppenstedt, A., Behrman**,** J.A., and Peterman**,** A. (2014). Gender in agriculture: Closing the knowledge gap. *Springer Netherlands*, eISBN: 978-94-017-8616-4.

Rao, M.S. (2008). Problems and prospects in Agricultural marketing: Where knowledge is wealth.

Reardon, T., and Timmer, C. (2012). The Economics of the Food System Revolution. *Annual Review of Resource Economics*. 4(1), 225-264.

Renkow, M., Hallstrom, D.G., and Karanja, D.D., (2004). Rural infrastructure, transaction costs and market participation in Kenya. *Journal of Development Economics*, 73, (2004) 349-367.

Renos, V., Sadoulet, E., and de Janvry, A., (2003). Measuring transactions costs from observed behavior: Market choices in Peru. *CUDARE Working Papers*, University of California, Berkeley, 962.

Reyes, B., Donovan, C., Bernsten R. and Maredia, M. (2012). Market participation and sale of potatoes by smallholder farmers in the central highlands of Angola: A double hurdle approach. *Michigan State University*, USA

Sadoulet, E., and de Janvry, A., (1995). Quantitative Development Policy Analysis. *John Hopkins University Press*, Baltimore.

Saigenji, Y., and Manfred. Z., (2009). Effect of contract farming on productivity and income of smallholders: The case of tea production in north-western Vietnam. Paper presented at the *27th International Association of Agricultural Economists (IAAE), August 16-22, 2009*, Beijing, China.

Shepherd, A., (1997). Market Information Services: Theory and Practice. *Food and Agriculture Organization of the United Nations*, Rome, Italy.

Strauss, J., M. Barbosa, S. Teixeira, D. Thomas, and G.J. Raimundo. (1991). Role of education and extension in the adoption of technology: A study of upland rice and soybean farmers in Central-West Brazil. *Agricultural Economics* 5(1):341-359.

Tschirley, D.L, and Ayieko M.W (2008). Assessment of Kenya's Domestic Horticultural Production and Marketing Systems and Lessons for future. *Tegemeo Institute of Agricultural Policy and Development, Nairobi*. Working Paper No. 30.

Vorley, B., Lundy, M. and MacGregor, J., (2009). Business models that are inclusive of small farmers. In da Silva, C., Baker, D., Shepherd, A.W., Chakib, J. and Miranda-da-cruz, S., Agro-Industries for development. *FAO and UNIDO*, Rome and Viena, pp 186-222.

Williamson, O.E. (1991). Comparative economic organization: the analysis of discrete structural alternatives. *Administrative Science Quartely*, Vol 36, No. 2, pp 269-296.

Williamson O.E., (1998). Transaction Cost Economics: How it works; where it is headed. *De Economist* 146, 23-58.

Williamson., O.S, (1985). The Economic Institution of Capitalism, Firms, Markets, Relational Contracting. *The Free Press*, Boston.

World Bank (2003). World development report: sustainable development in a dynamic world-transforming institutions, growth and quality of life. *World Bank*, Washington DC.

Zanello, G., Shankar. B., and Srinivasan, C.S. (2012). Transaction costs, information technologies, and the choice of marketplace amongst farmers in northern Ghana. *Paper presented at the 86th Annual Conference of the Agricultural Economics Society, University of Warwick*, United Kingdom, 16-18 April, 2012.

Appendix i: Variance Inflation Factor

Variable	VIF	1/VIF
Monitoring indirect cost	1.7	0.5887
Negotiation indirect	1.61	0.62123
Age	1.39	0.7181
Sex	1.34	0.74617
Vegetable farm size	1.31	0.76237
Experience selling vegetables	1.26	0.79373
Interaction with other farmers	1.25	0.80113
Veg:Total farm ratio	1.24	0.80379
Information search indirect cost	1.18	0.84518
Nature of sales	1.17	0.85294
Number of years in formal education	1.16	0.86108
Brokers	1.16	0.86335
Mode of transport	1.15	0.87209
Mean VIF	1.33	

Appendix ii: Pairwise correlation

	Information search indirect cost	Negotiation indirect cost	Monitoring indirect cost	Information search direct costs	Negotiation direct costs	Monitori direct co
Information search indirect cost	1					
Negotiation indirect cost	0.0012	1				
Monitoring indirect cost	0.2553	0.5478	1			
Information search direct costs	0.0261	0.4325	0.5527	1		
Negotiation direct costs	0.1865	-0.0341	-0.0122	0.0877	1	
Monitoring direct costs	0.2547	0.6824	0.5293	0.2744	-0.0412	1
Nature of sales	-0.097	0.1492	-0.0321	0.0035	-0.0898	0.0423
Interaction with other farmers	-0.1147	0.0524	-0.0461	-0.0496	-0.0681	-0.015
Experience selling vegetables	0.0262	-0.0379	-0.0146	-0.04	-0.0529	-0.081

	Interaction with other farmers	Experience selling vegetables
Interaction with other farmers	1	
Experience selling vegetables	0.1237	1

Appendix iii: Heckman two step model with total transaction costs

Table 6: Probit Model with Total Transaction Costs

Dep. Var = Choice of Market Channel (1= Sell at urban market, 0 = Otherwise)	Coef.	Rob Std. Error	z	P>z
Constant	-1.36	0.99	-1.38	0.16

Sex	-0.47	0.39	-1.2	0.23
Age	0.023	0.014	1.58	0.115
Education	-0.00	0.00	-1.34	0.179
Vegetable farm size	0.27	0.12	2.28	0.023
Experience farming	-0.00	0.00	-1.08	0.278
Use of middlemen	-1.21	0.40	-2.96	0.003
Interaction with other farmers	-0.21	0.44	-0.47	0.637
Mode of transport	-0.27	0.46	-0.58	0.564
Nature of sales	-0.69	0.43	-1.59	0.111
Veg:Total farm ratio	0.74	0.59	1.25	0.21
Total transaction costs	**2.11E-05**	**7.80E-06**	**2.69**	**0.007**
Use of brokers	0.96	0.35	2.72	0.006
Inverse Mills Ratio	6886.14	16078.6	0.43	0.668
Wald $chi^2(11)$= 84.57	Prob > chi^2= 0.000			

Table 7: OLS Model with Total Transaction Costs

Dep. Var = Profits	Coef.	Rob Std. Error	z	P>z
Constant	-48935	40508.3	-1.21	0.227
Sex	7572.67	12980.2	0.58	0.56
Age	335.751	484.747	0.69	0.489
Education	56.0883	89.054	0.63	0.529
Veg: Total farm ration	51997.2	17699.9	2.94	0.003
Veg farm size	11438.9	3964.3	2.89	0.004
Mode of transport	65554.9	15504.8	4.23	0
Use of brokers	33203.8	13920.8	2.39	0.017
Total Transaction Costs	**0.67599**	**0.27091**	**2.5**	**0.013**
Nature of sales	43291.6	22433.4	1.93	0.054
Interaction with other farmers	6337.07	13256.7	0.48	0.633
Experience farming	59.6828	23.9698	2.49	0.013

Appendix iv: Semi-Structured Questionnaire for Household Interviews

Supply Chain assessment for vegetables from peri-urban regions of Nairobi to the informal settlements of Nairobi

1. General Information (Smallholder farmer)

Farm location: ……...

Date of interview: ……/……/2017

Name of enumerator: ……..

Name of respondent: ……

Telephone number: 07……

Sex of the respondent (0) Male (1) Female	Age	Maximum level of years in school	Any skill from tertiary level education (0-No, 1-Yes)	Experienced years of vegetable production

2. Production information

a. What is the total size of your farm…….. (acres)

b. What size is under vegetable production…… (acres)

If they produce various vegetables, ask which takes the largest cultivated share of the farm.

c. Which vegetable takes the largest share of cultivated land……..

d. Why is it the most cultivated vegetable (*what informed that decision?*)

……

e. Vegetable production information

Vegetable (each on its row)	How much (quantity) do you normally sell/day? (specify units)	What price do you normally sell for per unit	How much (quantity) gets thrown away/day? (specify units)

f. What kind of storage space or preservation method do you have access to ……

i. Formal/commercial warehouse

ii. Informal but closed storage location

iii. Informal and open storage location

iv. No access

v. Other ……(*Specify*)

g. Which vegetable is fastest selling

……

h. How do you estimate the demand for your items…….

i. Based on exact requests

ii. Decide by self what should be sent out

iii. Send out what is available

iv. Other…… (*Specify*)

i. Do you track the movement of your goods through the supply chain?..... (0) No (1) Yes

j. If yes, how do you track this movement……

i. Through phone calls ii. Through face to face updates iii. Through SMS type messages

k. How is the commodity packaged from the farm to the market/upstream transporters?

i. Crate iv. Plastic packaging

ii. Sack (gunny bag) v. Other……

iii. Carton packaging

l. What is the main cause of vegetable being thrown away after harvest and before selling?

i. Delayed sell (Lack of market access/glut in the market)

ii. Poor storage

iii. Pests and disease

iv. Other…….. (Specify**)**

m. Do you have visits from extension officers or advisory persons……? (0) No (1) Yes

n. What is the nature of their visits?

……

o. How many times in the last year did they visit.....?

p. Do they provide any information with regards to **marketing** of vegetables?

……(0) No (1) Yes

3. <u>Market participation</u>

a. How did you know there is a market for your vegetables

……

b. How do you arrive at selling price

……

c. How much time do you spend on 3a and 3b?

3a……..Hrs

3b……..Hrs

d. Do you sell your produce to/through middlemen after harvest? …… (0) No (1) Yes

e. If yes, why?

……

f. Do you search for **better markets/prices** for vegetables in other places?..... (0) No (1) Yes

g. What do you do when you want to get **information on better markets/prices/increase sales** for your vegetables?

……

h. How much time do you spend on 3g?.....Hrs

i. Do you have a formal/informal contract/agreement with a buyer/broker or another actor in the market on transaction of commodities.....?

(0)No (1) Yes

j. What does the contract/agreement involve? (*contract information to be disaggregated as per the respective actor*)

…….

k. How much time does it take to negotiate contracts?…….Hrs

l. What enforcement mechanisms are used to ensure contract compliance?

……

m. How long does each of the vegetables sold stay at this location before being purchased after harvest

Vegetable	1)<24hrs 2)24-72hrs 3)>72hrs

n. What are the three main challenges faced as a smallholder farmer in market access and participation (*List from the most prevalent)*

……

o. What solutions would you suggest to these problems?

……

4. <u>Transportation information?</u>

a) Mode of transport to market ……(Specify kind e.g. animal cart, bicycle, self (on their back))

i. Own…….

ii. Hired……

iii. Borrowed…….

iv. Other…….(specify)

b) Time taken to the market from farm……..Hrs

c) What determines choice of transportation mode?.....

i. Cost of mode of transport

ii. Speed to reach destination

iii. Time of transportation

iv. Dependence on a particular mode of transportation

v. Most available mode of transportation

vi. Other…… (Specify)

d) *If they don't own their own mode of transportation*, do you lose sales because of unreliable service…….(0) No (1)Yes

e) Are you happy because of the price the transporter offered you?..... (0) No (1)Yes

5. Income information

a. Do you engage in selling other farm produce from your farm apart from vegetables?

……..…… (0) No (1) Yes

b. If yes, what is the reason for diversifying?

……

c. What is the monthly net profit from all your farming enterprises?..... (Probe for daily average)

d. What share of that monthly net profit is contributed by vegetable sales?

……

6. Social Capital

a. Is the farmer a member of any farmer producer/cooperative association in their respective farm locale……..

(0)No (1) Yes

b. *If yes,* what is the purpose of this association/benefits of this association

.....

c. *If yes to Qn 6a,* do they pay to be part of this association..... (0)No (1) Yes

d. *If NO to Qn 6a,* does the farmer have any interaction with other farmers who produce vegetables……

(0)No (1) Yes

e. *If yes to Qn 6d,* what is the nature of these interaction/benefits of this interaction?

.....

f. Have you influenced another farmer to participate in the vegetable market..... (0)No (1) Yes

g. *If yes,* what reason did you use to influence him/her

……

7. <u>Market and transaction cost</u>

a. Do you spend cash on activities involved in Qn. 3a……. 3b…….. 3g…… 3l……

(0)No (1) Yes

b. If yes, how much do you pay for it (*include the necessary interval*)

Qn 3a……..

Qn 3b……..

Qn 3g……..

Qn 3l……

c. Does the smallholder use urban market broker(s)……..(0)No (1) Yes

d. *If yes,* what does he/she use them for?

……

e. Are there any other costs incurred to participate in the vegetable market..... (0)No (1) Yes

f. *if yes,* what are they for: (include the interval; daily, weekly, monthly, annually)

……

(*Theft, security, subscription to SMS price information*)

g) Estimate the total production cost per month KES……

8. Based on the discussion with the farmer, data clerk to fill in the most predominant market channel farmer uses: …….