INSTITUTIONAL ARRANGEMENTS, SIDE-SELLING BEHAVIOUR AND CHOICE OF VERTICAL COORDINATION OPTIONS IN SORGHUM SUPPLY CHAIN IN KISUMU COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Master of Science Degree in Agribusiness Management of Egerton University

EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

I declare the thesis is my original work and has never been presented in any academic institution for the award of any certificate.

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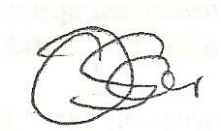
Recommendation

This research thesis has been submitted with our approval as the University Supervisors.

Signature..  … ……...… Date…15/05/2023……

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DEDICATION

I dedicate this work to my parents Joseph and Florence Nyamamba who have always invested in me their time and resources to enable me pursue my education. To my siblings: Nancy, Naom, Shyline, Intiana and Enock for their moral support, commitment and undying love. Equally to my son Shayne-Leone who gave me utmost motivation to work on my research.

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ABSTRACT

Vertical coordination (VC) in agriculture has received popularity in recent years. In the sorghum value chain, VC has emerged as a way to transform small-scale farm enterprises from subsistence to commercial orientation where they produce sorghum for industrial use. Factors motivating farm enterprise owners to engage in the different VC strategic options are not clear from the literature. Institutional arrangements have been hypothesized to play a role alongside the socio-economic and institutional factors but empirical evidence remains scarce. Moreover, cases of side-selling have been evident along different VC strategic options. This study bridged this gap by characterizing the institutional arrangements of the targeted VC strategic options. Also, the study determined the effects of institutional arrangements on the choice of VC strategic options and the extent of side-selling in the different VC strategic options. A stratified sampling technique was used to systematically select 274 sorghum farm enterprise owners in Nyando Sub-county, Kisumu County. Descriptive statistics, Multivariate probit and fractional response models were used in data analysis respectively. The majority of the sorghum producers targeted coordinated options, especially contractors and processors. Moreover, institutional arrangements such as prices that are close to expectations, bargaining power, grade certainty, quality inspection, payment delay and transportation arrangement positively influenced the choice of contractors and spot market. Besides, 71% of the contracted farmers side sold their produce due to higher prices offered in spot, lower bargaining power, sorghum experiences, contacts with extension officers and network externalities while off farm income, land size, access to credit, neighbourhood effect and trust reduced side-selling remarkably. Hence, the study recommends farm enterprise owners should be incorporating in setting sorghum prices increasing their bargaining powers. Also should be offered premium prices for delays and quality grade and good roads which will aid producers to utilize the new, lucrative and emerging cereal markets. Further, emphasis should be placed on trust between the buyers, higher bargaining power and monitoring of farm enterprises by use of neighbours in order to reduce side-selling. Additionally, buyers should offer better prices and advance payment on delivery in order to motivate producers to utilize coordinated markets and reduce the acts of side-selling.

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LIST OF ABBREVIATIONS AND ACRONYMS

AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CIDP	County Integrated Development Plan
CR	Composite Reliability
EABL	East African Breweries Limited
FAO	Food and Agricultural Organization of the United Nations
FAOSTAT	Food and Agricultural Organization Statistics
GDP	Gross Domestic Product
GoK	Government of Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIA	Interdependence Irrelevance Alternative
IMR	Inverse Mills Ratio
KMO	Kaiser-Meyer- Olkin
KNBS	Kenya National Bureau of Statistics
MVP	Multivariate Probit
NGO	Non- Governmental Organizations
OLS	Ordinary Least Squares
SPSS	Statistical Packages for Social Sciences
TCT	Transaction Cost Theory
USAID	United States Agency for International Development
VC	Vertical Coordination
VIF	Variance Inflation Factor

CHAPTER ONE
INTRODUCTION

1.1 Background Information

In African Sub-Saharan countries, agriculture continues to play a great role in the economy, and it is majorly dominated by small-scale farm enterprises in the production of agricultural products. The agrifood systems are changing rapidly towards modern value chains to meet the consumer demands for higher and secure products. Transformation of the agrifood system is responding to changes in dietary needs, rising incomes, urbanization and population growth (Reardon *et al*., 2019; Sitko *et al.,* 2017). Emergence and growth of retail outlets such as supermarkets and agribusiness firms coupled with their necessities on food grades and high standards have spurred up the reconstruction of the modern agrifood value chains (Henderson & Isaac, 2017). For the farm enterprise owners in developing countries to take up the opportunities, they need to coordinate their production and marketing activities to meet the predetermined food grades and standards for the market.

Agribusiness growth, food demand, and product differentiation have opened more opportunities for farm enterprise owners in developing countries opening up commercialization (Vroegindewey *et al.,* 2018). However, commercialization in Africa is being affected negatively by a lack of healthy and operational agrifood value chains limiting small-scale farm enterprise owners from accessing new technologies, technical services, quality inputs and market opportunities. The absence of these value chains makes it difficult for the farm enterprises to act following the stringent quality and safety necessities of the high-end markets (Alemu *et al*., 2016). To grab these opportunities, farm enterprise owners need to coordinate their activities in order to meet the required quality by agribusiness buyers.

Studies have shown that participation of farm enterprise owners in high agricultural value chains improves their welfare (Rao & Qaim, 2011; Saenger *et al*., 2014; World Bank, 2019). However, there are copious challenges that bind small-scale farm enterprise owners from participating in these value chains in developing countries. The major constraint stated is high transaction costs brought about by asymmetrical information on input and output prices, opportunistic actions, inadequate contract implementation and distrust (Shanoyan *et al*., 2019;). Other restraints identified are inadequate marketing systems, the poor association of input and output markets, inefficiency in production and management technologies and poor market infrastructures (Abdul-Rahaman & Abdulai, 2018; Andaregie *et al*., 2021). These challenges highlighted above remain unresolved restricting farm enterprise owners

from capturing and utilizing the prevailing market opportunities. To curb the problem of transaction costs which are fundamental to the farm enterprise owners, studies recommended that farm enterprise owners should participate in vertical coordination (VC) strategic options to ride on the available market opportunities.

Several forms of (VC) strategic options have been identified which regulate transactions of agricultural commodities. These strategic options range from open spot markets to vertical integration (Kataike & Gellynck, 2018). In the midst of these two strategic options, there are other vertical coordination strategic options which are specification contracts, relation-based alliances, and equity-based alliances. Contract farming has been identified as one of the best options of vertical coordination integrating small-scale farm enterprise owners in high agri-food value chains (Bellemare & Bloem, 2018; Carillo *et al*., 2017; Ton *et al*., 2018). The mechanism is commonly used in developing countries and can address constraints linked to market failures and high transaction costs issues. It bonds small-scale farm enterprise owners with the purchasers reducing their transaction costs and enabling them to gain access to other benefits that come with the use of contracts (Hassan *et al.,* 2020; Wang *et al.,* 2014). In contractual arrangements, the small-scale farm enterprise owners can get pre-financed by the buyers. This means that they get agricultural inputs for production, cash credit and technology and the charges will be incorporated in the final product (Bellemare, 2012). The corporate buyers of the contracted produce are always agribusiness firms and supermarkets.

Another arrangement is the spot market. Farm enterprise owners in the spot market supply their produce to the open market which has little coordination control and the 'unseen hand' of the marketplace, supply and demand, defines the price. The market offers great motivations for actors to adapt to the fluctuating market situations and experience low governance expenditures (Neves & Chaddad, 2012). The other two arrangements are relation-based and equity-based alliances. The arrangements use repetitive contracting to further their alliance goals. Additionally, the alliances have three objectives in common; a longer partnership with the exchange parties, shared objectives, risks, benefits and control and thirdly, reliance on the internal ex-post control mechanism to synchronize and resolve differences and upshots that came up (Vroegindewey *et al*., 2018).

The last mechanism in the continuum is vertical integration which occurs when a firms' asset specificity and transaction characteristics become too plentiful to be provided by a contract. The inside governance and control structures oversee the process safeguarding against opportunistic behavior. Vertical integration results from a merger between two firms,

acquisition of an individual firm by the other or rid of resources to another firm which will completely take over a particular function (Peterson *et al.*, 2001). Alternatively, the incoming firm could introduce production activities that did not exist before.

Sorghum (*Sorghum bicolor*) is a cereal, widely grown as a food crop in Sub-Saharan Africa. It is normally grown in arid and semi-arid environments characterized by low and erratic rainfall. It is ordinarily grown by small-scale farm enterprise owners for their household consumption and the surplus is traded in the domestic market (FAO, 2013). Sorghum may be used as food, the base ingredient in syrup manufacturing, grounded into flour, animal feed, production of ethanol and alcoholic beverages (EABL, 2018; FAO, 2013). Production of sorghum has been a victim of subsistence since it lacked a commercial market for the produce discouraging investment on new production technology, hence lowering its yields.

The beer market in Kenya has witnessed growth which is encouraging commercialization of sorghum as the main ingredient in the production of clear sorghum beer (FAO, 2013; ICRISAT, 2013). The demand has stimulated the development of the sorghum value chain in western Kenya especially in Kisumu. The chain involves partners in national governments, multinational companies, plant breeders, intermediary suppliers, and sorghum farm enterprise owners (van Wijk & Kwakkenbos, 2011). Some of the farm enterprise owners are involved in the chain and are utilizing different VC strategic options to market their produce. Despite the choices on these VC strategic options, farm enterprise owners side-sold their produce to existing alternative markets most preferably spot markets with attractive prices, breaching the agreement (Pultrone, 2012). The drivers motivating farm enterprise owners to choose different VC strategic options and later side-sell their produce has not been fully exploited and documented. The study intended to determine the role of institutional arrangements on the choice of different vertical coordination strategic options and the extent of side-selling along the different vertical coordination strategic options.

1.2 Statement of the Problem

Sorghum production for industrial use has emerged as a way to commercialize small-scale farm enterprise owners in Western Kenya. This is because the crop has the ability to adapt to climatic change, unlike barley which is the key raw material for brewing. With the initiative of commercialization, three VC strategic options (contractors, spot market and processors) were being utilized by the sorghum small-scale farm enterprise owners in view of accessing the output markets. Factors influencing choice decisions of the farm enterprise

owners were not clear in literature. Apart from the institutional and socio-economic factors, institutional arrangements were thought to play a role on the choice of VC strategic options. Besides, some farm enterprise owners involved engaged in side-selling which is viewed as a setback for the sustainability of VC arrangements. It has remained to be the main challenge in VC strategic option's operations. Some works of literature have tackled side selling such as Gallacher (2012), Goel (2014), Mujawamariya *et al*. (2013), Shumeta *et al*. (2018), and Repar *et al*. (2018). However, they did not take into account of important policy variables such as neighbourhood effect, extension contacts, level of bargaining power and network externalities alongside trust, credit provision, higher prices, off-farm income, delayed payment and experience in sorghum production. This study filled these knowledge gaps using a case study of small-scale farm enterprise owners in Kisumu County, Kenya.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of this study was to contribute towards the integration of small-scale farm enterprises owners into sorghum industrial markets through enhanced efficiency of vertical coordination strategic options in Kisumu County, Kenya.

1.3.2 Specific Objectives

i. To characterize the institutional arrangements of different vertical coordination strategic options targeted by small-scale sorghum farm enterprise owners in Kisumu County.
ii. To determine the effects of institutional arrangements on the choice of vertical coordination strategic options of small-scale sorghum farm enterprise owners in Kisumu County.
iii. To assess the extent of side-selling among the small-scale sorghum farmers along the different vertical coordination strategic options in Kisumu County.

1.4 Research Questions

i. Which are the institutional arrangements of the vertical coordination strategic options targeted by small-scale sorghum farm enterprises owners in Kisumu County?
ii. What are the effects of institutional arrangements on the choice of vertical coordination strategic options of small-scale sorghum producers in Kisumu County?
iii. Which is the extent of side-selling among the small-scale farmers along the different vertical coordination strategic options?

1.5 Justification of the Study

In Kisumu County, sorghum is one of the key priority crops being emphasized apart from rice, sugarcane, and cotton (CIDP, 2018). It has been identified as a lucrative enterprise that can improve the livelihood of the residents. A brewing plant has been established in the county seeking a steady supply of sorghum from the small-scale farm enterprise owners offering a ready market to the crop. The crop is also adaptable to the county's weather conditions thus thought to bring sustainable development in the county through efficient value chains. Commercialization of the crop is thought to achieve the goals of Agricultural Sector Transformation and Growth Strategy which emphases on increased incomes of small-scale farm enterprises owners, lessening the number of Kenyans who are food insecure and increase agricultural production and value addition (GoK, 2018). This is consistent with Vision 2030 and the Big four agenda of the Jubilee Government whose main goal was to ensure all Kenyans are food and nutrition secure.

Further, the study coincides with Sustainable Development Goals that aim at reducing poverty (Goal 1), achieve food security(Goal 2) and promoting sustainable agriculture (Goal 11) to achieve sustainable growth by 2030 (United Nations, 2015). As such, assessing the choices of sorghum producers in different VC strategic options integrates them in high-value markets through enhanced marketing thus improving the welfare of the agricultural enterprises. The study also added knowledge on the extent of side-selling of the small-scale agricultural enterprise owners in Kisumu County.

1.6 Scope and Limitation of the Study

This study covered only the sorghum value chain in Kenya specifically in Kisumu County which is one of the areas producing industrial sorghum for beer brewing. The study targeted small-scale farm enterprise owners who were producing sorghum for industrial use in the region to determine the influence of institutional arrangements on the choice of different VC strategic options and the extent of side-selling in three VC strategic options. The study relied entirely on the information provided by the respondent and probing was used to capture quality information during data collection.

1.7 Definition of Terms

Institutional arrangements- are policies, processes, and systems an organization uses to design and manage their activities to achieve their goals.

Side-selling- is the percentage of the marketable surplus that was sold to alternative markets.

Small-scale farm enterprises- These are production units devoted to agricultural processes with the primary objective of producing food and other crops. They are normally less than 10 acres of land.

Supply chain- is the integration of all functions that start from the production of raw material into a finished product and ends when the product reaches the final customer.

Transaction costs- are costs incurred when exchanging goods and are experienced when overcoming market imperfections. These costs include screening and selecting a buyer or a seller, obtaining information, bargaining and negotiating a contract and the cost of monitoring and enforcing the contract.

Vertical coordination- Refers to the synchronization of successive stages of production and marketing, with respect to quantity, quality, and timing of product flows.

Vertical coordination strategic options- are marketing choices ranging from spot market through hybrid to hierarchical arrangements engaged by small-scale farm enterprise owners during the transaction process.

CHAPTER TWO
LITERATURE REVIEW

2.1 The Kenyan Sorghum Sector

Sorghum (*Sorghum bicolor*) is a native food crop produced all over the tropical, semi-tropical and arid regions of the world (Muui *et al*., 2013). It is a self-fertilizing plant and it is drought tolerant better than maize thus referred to as the camel of the plant kingdom. The plant has been noted to be the most significant cereal for human ingestion outshined only by maize, barley, and rice (Chepng'etich *et al.*, 2014). In Kenya, sorghum is one of the climate-smart food crops which have a wide adaptation, resilience, as well as high nutritional value (Bolanle *et al*., 2017). It has been rated fourth in footings of cereal production after wheat, rice and maize (Chimoita *et al*., 2017) and also, it has been found out that sorghum does well in a variety of soils even in those soils with the lowest fertility (KIRDI, 2011). The crop also thrives well in the Kenyan conditions because it is normally heat and drought tolerant. The crop is grown throughout the country thus becoming a chief food crop for the lowest pay families in Kenya (Njuguna *et al*., 2018). Sorghum is meticulously linked to maize in terms of consumption making it a substitute crop for arid areas susceptible to drought (FAO, 2013; Muui *et al*., 2013).

Most farm enterprise owners in the country have been growing the red varieties of sorghum, though in small quantities since most of them took it as a poor man's food. Moreover, there has been an inadequate marketplace for it. The market channels for sorghum have also been stagnating over the years because of the low production (Bolanle *et al*., 2017) further driving sorghum to be marketed thinly. It was estimated that 30% of the domestic product was marketed (Mwadalu & Mwangi, 2013). Then again, the little that was transacted was marketed using the traditional marketing channels which entail exchange between family, neighbours and informal avenues (EABL, 2018). However, recently a modern marketing system has come up where there is some sort of prearrangement between farm enterprise owners and the buyer with pre-set conditions for production and marketing. The buyer supplies the farm enterprise owners with extension services, land preparation services and farm inputs to farm enterprise owners and then takes off the total cost of the services and inputs from the amount paid to the farm enterprise owners after delivery (EABL, 2018).

In Kenya EABL through East African Maltings Limited (EAML) signs agreements with farm enterprise owners who are passionate to produce the recommended sorghum varieties for processing beer. This ensures that farm enterprise owners sell their complete harvest whereas the malting company meets its predetermined production and quality

requirements. As such, EABL provides a ready market at a specified price and other technical and support services until the crop is ready for harvest. The company also ensures availability and accessibility to better quality sorghum seeds at a reasonable price (EABL, 2018).

According to the Kenya National Bureau of Statistics (KNBS, 2017), EABL is facing competition for sorghum from flour processing companies (such as Unga Limited), feed processing companies and also companies processing sorghum to ethanol and syrup (EABL, 2018). To counter the increasing demand, the sorghum potential needs to be exploited fully through trade and commercial production of the commodity. Information on trade from FAO indicates that Africa permits the importation of sorghum up to one million tons per year (USAID, 2010). To meet the internal demand, the buyers have been encouraged to coordinate with the farm enterprise owners in order to obtain a steady supply of the produce.

2.2 Vertical Coordination and its Benefits

According to Trifković (2014) and Hung Anh *et al*. (2019), Vertical coordination (VC) is the harmonization of activities and choices of two or more autonomous actors with a buyer-seller association in a chain and this mechanism synchronizes the sequential stages from production to marketing in relation to quality, quantity, and timing of the product. Zhong *et al*. (2018) argued that VC is a continuum and the more the interdependent the activities between the seller and buyer, the more the coordination which increases the information interchange and mutual decision making between the actors. Trifković (2014) approved that VC has an array of coordination ranging from inept spot market on one end to vertically integrated exchange on the other end of the corporation which is regarded as hierarchies. The hierarchies exhibit several forms from contracts, strategic alliances, partnerships, joint ventures, and non- profit organizations.

According to Vroegindewey *et al*. (2018), VC arose as a result of market failures since sophisticated transaction costs such as information search and monitoring costs connected to procuring in spot markets encourage firms to internalize or contract production. Equally, moving away from spot market transactions to closely coordinated associations expands the capability of processing firms to address the problem of information asymmetry and also obtain a sufficient supply of raw materials whereas reducing production and transaction costs (Trifković, 2014). Another motivation for VC is the risk-sharing approach whereby, it is seen to decrease business dangers. According to Humphrey and Schmitz (2002), the peril of supplier letdown is gotten to be high compelling the coordination of the chain to more complex coordination forms. Alternatively, the matching between upstream

and downstream firms can be realized through standards as they enable conveying of information on production and processing between the trading partners.

Standards enable consumers to gauge the quality and safety of the products which diminishes consumers' uncertainty and information asymmetry. Through this, trust increases on certified products (Maertens *et al*., 2012; Trifkovic, 2014). Henson and Humphrey (2010) added that the quality and safety of foodstuffs in the ultimate market help farm enterprise owners in developing countries to gain and access markets while on the other hand, standards reduce price competition and create an upturn in profits through product differentiation. Carillo *et al*. (2017) also added that the coordinated farm enterprise owners normally benefited due to higher market prices offered to them and increases their bargaining power on the goods to be supplied. Therefore, contracts are viewed as an effective way of providing downstream market information, reduces uncertainties on markets while protecting buyers from supplier holdup (Vroegindewey *et al*., 2018).

Various studies (Cadot, 2015; Franken & Bacon, 2014; Goncharuk & Gamma, 2013; Zhong *et al.,* 2018) have built upon the positive effects of VC. Cadot (2015) found out that the agency expenses in the highest VC strategic option are lower in the French wine industry than the farms which are not integrated. Franken and Bacon (2014) also studied the organizational arrangement of the developing Illinois wine industry then established that vertical integration improved the quality of grapes. Goncharuk and Gamma (2013) found that a vertically coordinated agrarian establishment improves the effectiveness of dairy enterprises in Ukraine. On the other hand, Zhong *et al.* (2018) claimed that VC is a means to coordinate the quality, capacity and the delivery time of products.

Other authors Bellemare (2012), Carillo *et al*. (2017) and Narayanan (2014) have found that the welfare of farm enterprise owners increases when they participate in higher VC strategic options. Carillo *et al*. (2017) examined onion and apple farmers in China and found out that those farmers in contract farming received a higher income than those in the spot market. Similarly, an evaluation carried out at six districts in Madagascar on various farm types and crops showed that an increase of 1% participation in contract farming has a direct outcome on farmers' returns of more than 0.5% (Bellemare, 2012). Narayanan (2014) carried out a VC impact assessment in some value chain in southern India and found out that profits from each sector were heterogeneous. The profits were higher in papaya and chicken meat as well as on contract scheme and in farm type. Narayanan (2014) also carried out a profit decomposition exercise in coordination and found that the coordinated farmers realized higher incomes which were used to compensate for the higher costs they incurred

2.3 Characteristics of Different Vertical Coordination Strategic Options

In developing countries, farm enterprise owners get linked to consumers through a sequence of arrangements ranging from spot market through contracts to full vertical integration of ownership of all transaction stages. The results of these diverse arrangements on the patrons of the current agri-food sector are highly debated.

Spot markets are the lowest and simplest form of VC whereby transactions are coordinated only by prices and there is no continual obligation amongst those engaging in that strategic option as there are no legal mediations if the farm enterprise owners strolled away from the treaty (Vroegindewey *et al*., 2018). According to Chang *et al*. (2018), the intensity of coordination is extremely low while the unseen hand of the market defines the price and the standards. The only control that the two parties have is to participate in price finding prompting them to make a decision which is either yes or no to the transaction. On the other hand, the only ex-post control decision to be made is to replicate the business deal with a similar party if such recurrence is required in the near future. Vroegindewey (2015) added that the asset specificity, uncertainty, and frequencies are low, the duration of the transaction is short and less information is shared among the actors.

Specification contracting is the second strategy of VC whereby there is a predetermined arrangement between the buyer firm and a farm enterprise owner for a specified term and the agreement is either orally or in the script before production (Vroegindewey, 2015). The mechanism can provide financial or material resources to the farm enterprise owners and state the product or process requests designed for agricultural production taking place on the land owned and controlled by the farmer that provides the firm with the legal title to the crops and livestock (Prowse, 2012). According to Soullier and Moustier (2018), Contracting has been the intermediary form of VC and has been on the rise since the 1960s in the private sector in reaction to the high demand for quality products. It appears once the uncertainty and asset specificity have elevated due to the perishability of produce, difficult to store, transportation and the heterogeneity of produce (Minot & Sawyer, 2016). The invention has been increasingly in use since the 1980s in Africa in the different value chains such as horticulture and animal products where agricultural and input marketplaces have failed recurrently (Soullier & Moustier, 2018).

According to Peterson *et al*. (2001), the characteristic of specification contracting is higher coordination control, unlike the spot market. The two parties employ coordination controls negotiated ex-ante and also agree on the incentives for achieving the set specifications. Again, the parties invest their time and attentiveness past price finding and a

decision of yes or no to the transaction. During ex-post, parties practice control by monitoring the contract and as well making decisions of renewing or renegotiating the agreement or again, seek for the third party who will enforce in case one party misses to perform. The control in ex-post is intense than in spot markets through its success largely depends on the ex-ante control exercise.

Relation based alliances come about when farm enterprise owners are involved in a repetitive exchange and normally share the perils and paybacks (Tidiane Sall *et al*., 2019). A study by Vroegindewey *et al.* (2018), argues that a farm enterprise owner qualifies to be relation based if at all it exhibits three characteristics namely, mutual objective identification, exercise mutual decision making and also share mutually the risks and the benefits. The strength of coordination control is advanced than for spot and specifications contract markets. The frequency in relation based is medium, the asset specificity, duration of transacting, ex-post control and information sharing is also medium (Vroegindewey, 2015).

The equity-based alliance is structural arrangements that share equity assets amongst the actors in the exchange relationship (Bhattarai *et al*., 2013). The feature distinguishing the alliance from others is the existence of the formal organization intended to conduct transactions. According to Menard and Shirley (2018), the coordination control is organizational but still, the control has been decentralized to the parties owning it and the parties have a separate identity that permits them to stroll away after the exchange. Nevertheless, the walk-away has been reduced by the presence of a considerable investment in the modern independent identity. During the ex-ante, there is a negotiation in the establishment of the decentralized organization which will oversee the ex-post tenacity of the coordination issues and control is delegated to the new organization as the parties observe on the results (Menard & Shirley, 2018).

The actual authority is exercised during the ex-post not in ex-ante. The farm enterprise owners form the modern cooperative entity and do not give up on their separate identities. During ex-post, farm enterprise owners exercise power through the board of directors who sets procedures and policies for the accomplishment of all the transactions thus high frequency and asset specificity, low uncertainty, longer duration of the transaction, high ex-post control and higher information is shared (Menard & Shirley, 2018).

Vertical integration is the establishment of a single organization that regulates and controls downstream and upstream activities (Bhattarai *et al*., 2013; Vroegindewey *et al*., 2018). This strategy is used by a firm to increase its control over the suppliers to heighten the firm's authority in the market, cut the firm's costs and acquire the distribution channels.

Vroegindewey (2015) stated that the control processes in vertical integration are increased since the room of decision making is complex and yet re-separating of the parties after the engagement is complex. In ex-ante, there is a negotiation on the ex-post governance arrangement as well as in ex-post, control comes in to ensure that the government guidelines and techniques have been accomplished effectively for the central organization. Thus, the frequency and asset specificity are very high, there is no uncertainty, actors transact for longer periods, very high ex-post control and extensive information sharing.

2.4 Drivers of Vertical Coordination Strategic Option Choices

Vertical coordination (VC) choices and standards determine the organization and the relations in a value chain. This far, farm enterprise owners have not been asked directly about their incentive to get into the different VC strategic options and according to Masakure and Henson (2005), motivations are inferred from the seen effects in production and marketing conditions. According to Barrett *et al*. (2012) and Carillo *et al*. (2017), coordination of farm activities depends on characteristics of the farm enterprise owners such as risk abhorrence, entrepreneurs' competence, technical skills, and networking.

Kneafsey *et al*. (2013) revealed that farm enterprise owners involved in direct sales are always younger, experienced, more educated, future-oriented and open than average. Nonetheless, some results have indicated that market-oriented farm enterprise owners are older than the enterprises working in other food systems (Kneafsey *et al*., 2013). Likewise, educated and innovative farm enterprise owners are likely to attempt to utilize different VC mechanisms and also are open to change (Kneafsey *et al*., 2013).

Another motivation is the desire to make profits. According to Kneafsey *et al*. (2013) and Nguyen and Kim (2019), the most significant factor that pushes farm enterprise owners to get involved in the higher levels of VC strategic options are greater profits. Revenues have a positive effect on the choice of VC strategic option and also in selecting the matching governance structure theorized for both forms of markets. Bellemare (2012) added that farm enterprise owners are likely to participate in higher levels of VC strategic options if at all the expected benefits exceed those of alternatives present. Similarly, delayed payment due to longer supply chains initiates farm enterprise owners to search for options that pay them promptly and where they can interact with the consumers directly (Arouna *et al*., 2017). Therefore, prompt payment is anticipated to have a positive effect on the participation of farm enterprise owners in VC strategic options.

Also, there is an assumption that producers are risk-averse and this motivates farm enterprise owners to participate in the higher levels of VC strategic options. According to Michelson *et al*. (2012) and Nguyen and Kim (2019), farm enterprise owners participate in VC strategic options to avert product price risks and Abebe *et al*. (2013) added that farm enterprise owners have diverse risks likings for the various markets they operate in. Alternatively, some studies have found that elements that lessen transaction costs minimize risks and lessen behavioral uncertainties increases the likelihood of selecting particular VC strategic options (Abebe *et al*., 2013; Gelaw *et al*., 2016; Ochieng *et al*., 2017).

As well, there is a proof that behavioral inclinations such as trust, time and risk preferences play a great role in farm enterprise owners' preference on VC strategic options (Clot & Stanton, 2014; Fischer *et al*., 2017). Wuepper and Sauer (2016) found out that social capital particularly trusts and acknowledged self- efficacies have positive impacts on the number of pineapples traded to export firms unlike local sellers in the pineapple sector in Ghana. Additionally, Schipmann and Qaim (2011) and Gelaw *et al*. (2016) argued that personal relations with customers play a vital role in marketing choices. On the other hand, Ochieng *et al*. (2017) debated that postponed payment upsurges the risk of defaulting of contract partners.

According to Abebe *et al*. (2013) and Arouna *et al*. (2017), contract attributes and arrangements are decisive factors influencing small-scale farm enterprise owners to participate in contract farming by affecting their projected level of utility. Equally, disapproving contract design limits the involvement of farm enterprise owners in VC strategic options (Otsuka *et al*., 2016; Schipmann & Qaim, 2011). Producers occasionally sell their products to traders in the chain out of information asymmetry. The traders take advantage of the ignorance of farmers on the current market prices triggered by remoteness and poor communications in the marketplace (Montalbano *et al*., 2018). However, Andersson *et al*. (2015) stated that, sometimes, small-scale farm enterprise owners are not able to participate in supermarket channels due to deficiency of financial and human capital or occasionally drop out of agreements for causes not entirely clear.

2.5 Link between Vertical Coordination Strategic Options and Transactional Theory in the Agribusiness Sector

Transaction Cost Economics is one of the theories in New Institutional Economics (NIE) which emphases on transaction cost and the factors influencing the choices of vertical coordination strategic options (Sent & Kroese, 2022). The theory primarily stresses the expenses intertwined when making business transactions other than the costs of production

(Djalalou-Dine *et al*., 2012). The degree of transaction cost is usually defined by features such as asset specificity, uncertainty, and frequency and associated them to the institutional arrangements which range from open spot markets on one end of the continuum to vertical integration on the other (Djalalou-Dine *et al*., 2012; Hao *et al*., 2017). Asset specificity occurs when assets can or cannot be diverted to alternative uses (Sent & Kroese, 2022). When the household assets can easily be averted to other uses, the open market is the ultimate institutional arrangement farm enterprise owners can opt for to minimize costs. Also, low or high uncertainty can be a driver to VC strategic options' choice decision of farm enterprise owners.

According to Gerdoci *et al*. (2016), Hao *et al*. (2017) and Sent and Kroese, (2022) this is the incapacity to foresee in the future and it is brought by bounded rationality and opportunism which come up as it is expensive to find disloyal individuals. Therefore, a farm enterprise owner selects an ideal institutional arrangement that minimizes the transaction costs of a given business deal (Djalalou-Dine *et al*., 2012; Schweitzer *et al*., 2011). The differences in transaction features bring about the discrepancies in transaction costs such as information costs, negotiation costs, and monitoring and enforcement costs (Stranieri *et al*., 2018). Data costs are associated with the time and effort spent in obtaining the market information to complete transactions between the buyer and the seller. Negotiating costs are linked to how difficult to establish and settle contracts or agreements. Monitoring is associated with tracking and enforcing agreements or contracts (Gerdoci *et al*., 2016; Lin 2017). Transaction cost economics theory recommends that the advanced the costs of the transaction, the greater the likelihood of farm enterprise owners to opt for a higher level of VC strategic options that are equity-based or vertical integration. Transaction costs are divided into two costs namely the ex-ante and ex-post costs.

In ex-ante, the costs are incurred in advance and during transactions. These costs include information cost, search costs and costs of negotiating and establishing contract agreement (Lin 2017). According to Zhou (2006), information cost entails the fluctuation of prices, access to information and quality inspection. The cost of negotiation is determined by the bargaining power of farm enterprise owners, payment delay, transportation costs, human asset, and farm specialization. On the other hand, Ex-post costs are the costs arising from transactions, such as the costs of tracking and enforcing contracts or agreements (Gërdoçi *et al*., 2016; Korir, 2015; Lin 2017). These expenses ensure that other parties to the agreement adhere to the terms of the contract, such as quality standards and payment arrangements

(Suhaimi *et al* 2017). The monitoring costs are trust in buyer, grade uncertainty and farm services.

Trust in buyers captures the opportunity costs of mobilizing the producer's time and efforts against the grading and pricing information asymmetry problem between buyers and sellers (Ndoro *et al*., 2015; Suhaimi *et al.,* 2017). Farm services apply to technical assistance provided to farmers by buyers. These reduce the cost of monitoring in terms of reducing the commitment of farm enterprise owners since the service is provided by buyers. Lastly, grade uncertainty is the cost incurred if the farm enterprise owner does not meet the expected grade. Although the price is agreed upon in the ex-ante, the return may be lower than expected if at all the product does not meet the anticipated grade (Zhou 2006).

Transaction costs always pose challenges when it comes to their measurement and for a lack of an obvious definition existing for them, they are assumed to be hidden costs. Hobbs (1997) recommended the measuring of transaction costs by use of information and search expenses, costs of bargaining, and monitoring expenses. Williamson (1985) also suggested a method that concentrated on transaction features which can only be applied in bilateral monopoly markets while Barzel's (1982) design was not applicable since it associated property rights to transaction costs. The Hobbs design has been used broadly in microeconomic research, thus this study will employ the method.

Gërdoçi *(*2016) has acknowledged the postulation that increased transaction costs result in vertical integration or other hybrid types of governance. Investigating the pork chain in China, Ji *et al*. (2012) concluded that transaction costs and "collaborative advantages" are the two factors that determine the decision of slaughtering and processing companies to choose more secure governance structures. Weseen *et al*. (2014) conducted a case study where he centered on ethanol plant managers and buyers representing different sectors such as grain products, livestock, and biofuels and came up with a conclusion that transaction costs are both a determinant of hybrid and hierarchical forms of governance and an outcome of such complex governance structures. The more channel participants face higher transaction costs, the more they opt for some form of collaboration or instruments to govern exchange relationships.

The basic premise of the cost theory of transactions (TCT) is that under certain circumstances the cost of transactions may be too high. In such situations, organizing the economic transaction within the firm or hierarchy governance structure may be preferable to organizing it at a market-based governance structure (Gërdoçi *et al*., 2016). In this regard, rising transaction costs play a significant role in the selection of business relationship

governance structures (Abdulai & Birachi, 2009; Lin 2017). Market exchange is recommended once transaction costs remain low. Transaction Cost Economics authenticates that the marketplace is always the least-cost producer of given services or goods. Alternatively, the internal governance structure is commended as soon as the transaction costs stay high.

2.6 Side-selling Behaviour in Vertical Coordination Strategic Options

Side-selling is a renowned vice in vertical coordination (VC) strategic options that affect both small-scale farm enterprise owners and aggregators. It occurs when yields are sold to alternative VC strategic options other than the targeted one which did not offer any service to the producers such as the provision of inputs and technical services (Bellemare, 2012; Repar *et al*., 2018). This problem is brought by incomplete arrangements and institutional letdowns since the legal institutions are not functioning properly especially in developing countries (Kunte *et al*., 2016; World Bank, 2012).

According to Kunte (2016), the traditions and customs of economic forecasts that investment and exchange flop as there is a fear of breaching and holdups. Even if courts were to be present, legal action could not be taken in the breaching of agreements in agriculture as they will be restricted by the transaction costs. This has forced most of the agricultural aggregators to use third parties who are private or use informal mechanisms such as repeated dealings and reputation to improve the mutual trust among the actors during ex-ante and help resolve disputes in ex-post (Kunte *et al*., 2015).

Repar (2018) and Shepherd (2007) gave a valuable intuition on the drivers of side-selling stating that small-scale farm enterprise owners have inadequate prospects of getting income and over and over again need money to meet their dietary needs of the households. Alternatively, Malan *et al*. (2015); Mujawamariya *et al*. (2013) and Shumeta *et al*. (2017) stated that delays in payment induce small-scale farm enterprise owners to side-sell the coordinated produce to traders. Correspondingly, Minot (2011) and Monteiro *et al*. (2017) revealed that once prices in alternative VC strategic options increase than the VC price farm enterprise owners tend to side-sell. This is because the attitude of a small-scale farm enterprise owner is to get the utmost price for the scarce quantities produced then if the VC strategic option engaged in does not bid the highest, the small-scale farm enterprise owner will hunt and sell their produce out of the VC strategic option (Shepherd, 2007). Minot (2011) and Monteiro *et al*. (2017) added that sharing information, group membership and

regular monitoring can regulate side-selling and defaulting in higher levels of VC strategic options.

Side-selling seems to be economically unsound, but it remains to be a rational decision from a small-scale producer's livelihood perspective (Mujawamariya *et al*., 2013). However, side-selling has remained to be the main challenge for VC strategic options operations as it breaches the trust of the two actors, increases the buyer's transaction costs and terminates the agreement (Repar *et al*., 2018). Some works of literature have tackled side-selling such as Gallacher (2012), Goel (2013), Mujawamariya *et al*. (2013), Repar *et al*., (2018) and Shumeta *et al*. (2017) but much has not been documented on what motivates farm enterprise owners to side-sell and the extent of the side-selling in the different VC strategic options. The study seeks to contribute to literature the extent of side-selling in the different vertical coordination strategic options.

2.7 Theoretical Framework

2.7.1 Transaction Cost Economics Theory (TCE)

This study was grounded on the transaction cost economics theory which provides a witty hypothetical outline on the employment of the different VC strategic options in the marketplace to economize on the transaction costs. It also assumes that human beings are naturally opportunistic and informal enforcement measures are needed to deal with the opportunistic behaviors of beings thus the theory was seen appropriate for the study.

The TCE model proposes a comparative evaluation approach that asserts that the best governance mechanism is the one that can minimize the transaction costs, protect the specific assets from mal-adaptations and holding-up impediments (Kim & Mahoney, 2005). The TCE theory was initiated by Ronald Coase (1960) in his article termed as "the problem of social cost" and stated that the market functioning infers definite detailed costs known as transaction costs. These transaction costs include search costs, negotiating costs, contracting costs monitoring costs, enforcing contracts, bonding costs, and costs of safeguarding agreement. These costs run the economy and they are considered as wastes thus should be kept as squat as possible. Later, Oliver Williamson in the 1970s contributed to the theory by renovating the model to a candid paradigm adding the concepts of asset specificity, uncertainty, complexity, and frequency.

Asset specificity has remained the ingredient of transaction costs theory and this occurs when some of the members capitalize on human, physical, site and brand name assets and these assets cannot be recuperated when the agreement is interjected. This asset

characteristic force trading parties to get involved in the higher levels of VC strategic options (Hao *et al*., 2017). The second attribute of the transaction is uncertainty. This occurs when the trading parties are not able to foresee the forthcoming incidents and as well, are unable to predict what will happen when transacting. When uncertainty escalates to uneconomical levels designed for procurement, price discovery and monitoring behaviour of the counterparts, the trading parties will develop traits of mutual dependence and sharing of information to minimize those costs (Signorini *et al*., 2015). The elevated heights of uncertainty force parties in a transaction to adopt the higher levels of VC strategic options.

The third attribute is complexity. It is brought about by information asymmetry and uncertainty. When parties make choices cantered on diverse information, it forces them to get involved in complex transactions. As complications intensify, it makes the partners vulnerable to breach contracts forcing them to incur more safeguards to protect their specific assets. According to Masten (1989), the more the complication, the higher the probability of the parties getting bonded thus participating in higher levels of VC strategic options. The frequency is the last attribute of transaction cost and it is how often transactions are repeated in the marketplace. In nonexistence of VC mechanism, recurring transactions render members to opportunism forcing the parties to exercise in higher VC strategic options. The higher frequencies of transactions reduce the opportunistic behavior since the members are scared of impairing their reputation in the future (Weseen *et al*., 2014). In Williamson's model, He predicts that repetitive transactions direct the parties in the direction of higher VC strategic options.

2.7.2 Random Utility Theory

The study also based producer's choice on Random Utility Theory supposing that sorghum farm enterprise owners were motivated to participate in the different vertical coordination strategic options based on utility maximization (Yakubu *et al*., 2022). They participated in vertical coordination strategic options when they thought they could get maximum profit from the selected coordinated options. The Random Utility Theory has three assumptions: the first one is Generic decision maker who make a choice after considering alternatives in his or her choice. The second one is a decision maker who assigns each substitute a perceived utility and selects alternatives with maximum utility and the last assumption is the utility apportioned to each choice which depends on the number of attributes and the decision maker (Yakubu *et al.,* 2022). The utility derived can be represented in two components: Deterministic component where observed attributes are

determined and Random component with unobserved attributes. Deterministic component is observable which includes farmer and farm attributes and random component results from omitted variables such as missing data, misspecification and measurement errors, this function is specified below:

$$AZik = X\beta + \varepsilon \quad 1$$

AZik is the Utility obtained when substitute k was chosen by a farm enterprise owner I, Xβ is the deterministic component where x is the vector of the exogenous variable while β is the parameter to be estimated as ε is the error term.

2.8 Conceptual Framework

The conceptual framework in Figure 1 illustrated the various determinants influencing choice decisions of small-scale farm enterprise owners on different VC strategic options. The drivers captured entailed the socio-economic factors, institutional arrangements and economic motivators. Socio-economic, institutional arrangements and economic motivation influenced the informed choices of the targeted VC strategic options before and during production. Equally, it directly influenced side-selling behaviour of farm enterprise owners during marketing of their produce motivating farm enterprise owners to opt for alternative VC strategic options available within their reach. Also, the study had the moderating variable (institutional and climatic factors) which influenced dependent and independent variable positively and as well as side-selling behaviours of the farm enterprise owners. These informed decisions were thought to enhance integration of these small-scale farm enterprise owners in high sorghum industrial markets.

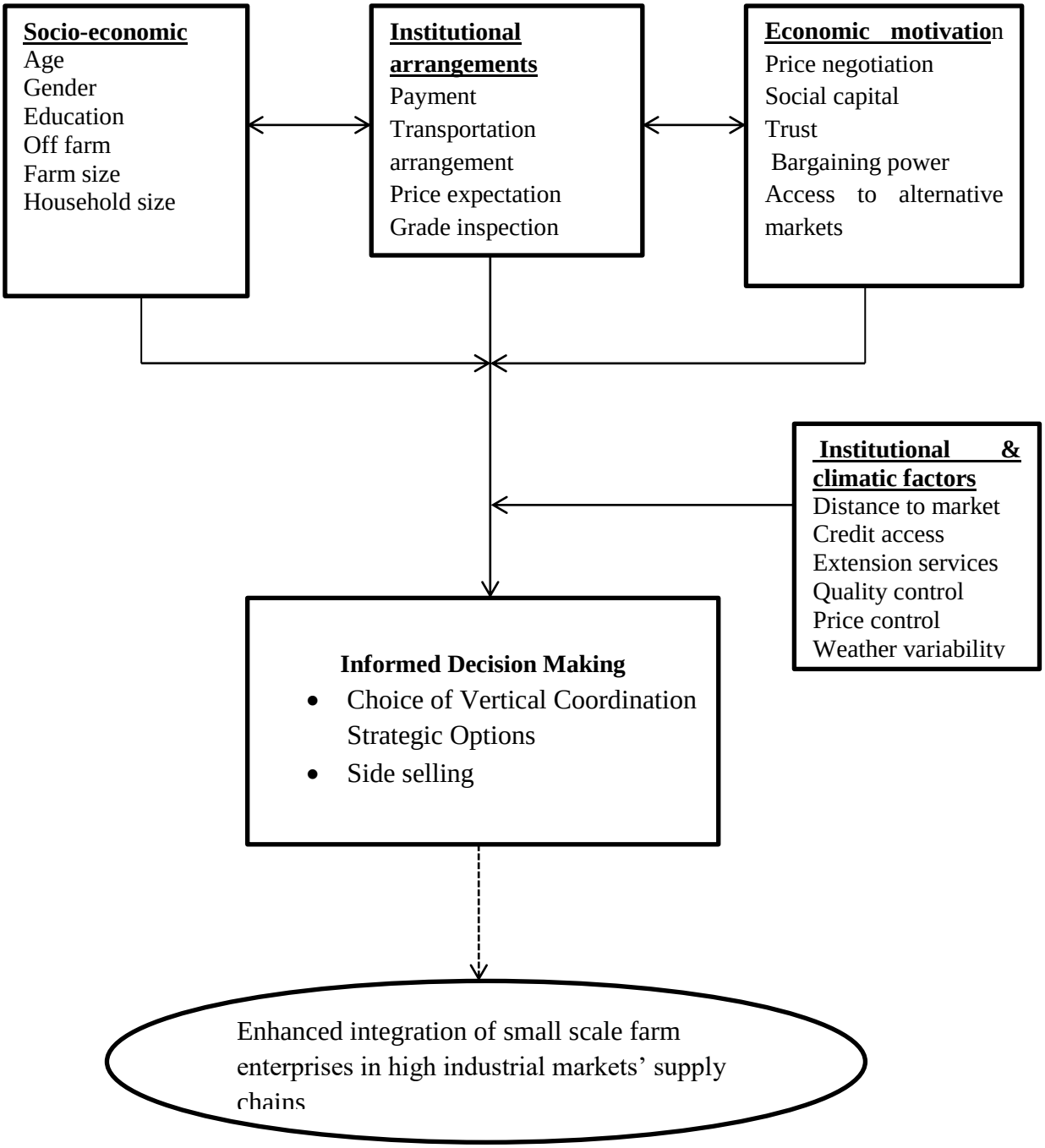

Figure 1: Conceptual framework on the relationship between factors and choice of vertical coordination strategic options and side-selling behaviour.

CHAPTER THREE
METHODOLOGY

3.1 Study Area

The study was conducted in Kisumu County, one of the counties promoting the development and growth of drought-resistant cereals such as sorghum to increase the income and welfare of the farm enterprise owners (CIDP, 2018). The County covers a total land area of 2085.9 square kilometers (GoK, 2012). It lies within longitudes 33° 20’ and 35° 20’E and latitudes 0° 20’ and 0° 50’South (KNBS, 2015). It is surrounded by Nandi County to the North East, Homa Bay County to the south, Kericho County to the East, Siaya County to the west and Vihiga County to the North West. In 2009, Kisumu County had a population of 968,909 people, 35% of whom were categorized as a youth (15- 29yrs). The County’s total population is 1,155,574 million people (KNBS, 2019).

Altitudes vary from 1144 meters on the plains to 1525 meters in the Maseno and Lower Nyakach areas, strongly influencing rainfall and temperatures in the County. These areas have a bimodal rainfall pattern; the long rains usually occur between March and May and the short rains occur between October and December. Rainfall data indicates that the county receives substantial rainfall. During the short rains, the average annual rainfall ranges between 450 mm and 600 mm (GoK 2012). The mean annual maximum temperature ranges between 25°C and 35°C, while minimum temperatures range between 9°C and 18°C.

The study was based at Nyando Sub-County which has a cooperative by the name Obuso Border whose main aim is to reduce transaction costs and improve the transaction efficiencies of the members. It also had five contractors who had obtained the agency number from the malting company which allows them to consolidate the produce and sell it to the industry reducing the farmers’ transaction costs. The contractors were Transu limited, Mosco, Rollys, Kisumu heralds, and East Africa Affordable. Also, some farmers had the Agency to distribute directly to the EABL (processors).

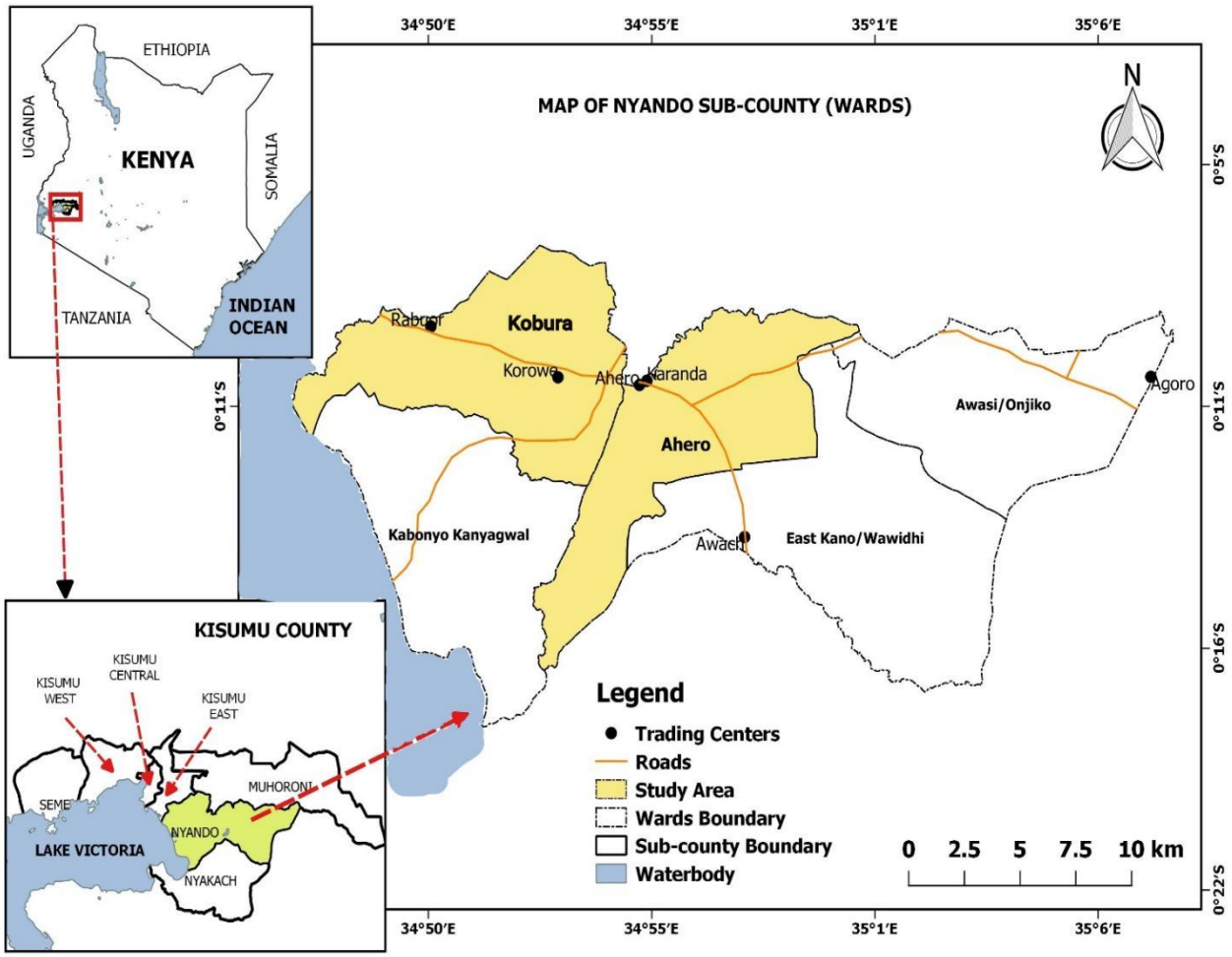

Figure 2: Map of the study area, Nyando Sub- County

Source: Geography Department, Egerton University (2019)

3.2 Research Design

In accordance with Kothari (2006), the cross-sectional design was used to acquire information about the existing phenomena to describe it with the variables in place. This allows explanatory and explained variables to be estimated concurrently. It assessed institutional arrangements, institutional factors and socio-economic factors as the determinants influencing the choice of VC strategic options and side-selling of farm enterprise owners in Kisumu using analytical analysis. Equally, descriptive survey design was adopted to characterize the institutional arrangements in the different vertical coordination strategic options. This is because descriptive survey design aims at gathering information regarding a certain phenomena (Aggarwal & Ranganathan., 2019).

3.3 Sample Size Determination

The sample size was determined using Yamane (1967) formula since the population was known. According to statistics obtained from Nyando Sub-county, 870 of farm enterprise owners were engaged in VC strategic options in the two wards (Kobura and Ahero) while the sample size was 274 households as shown below

$$n = \frac{N}{1 + N\,(e)^2} \quad \text{.....2}$$

Where n was the desired sample size, N was the size of the population and e was the level of precision. The population was 870 and the precision level was at 0.05 since the sample size was calculated at 95% confidence level.

$$n = \frac{870}{1 + 870\,(0.05)^2} = 274 \quad \text{Respondents}$$

3.4 Sampling Procedure

The study employed a multi-stage sampling design. In the first stage, Kisumu County was purposively selected since the county government was promoting the production of sorghum in order to improve the welfare of the residents. It is also among the few counties with an established brewing plant which sources sorghum from small-scale farm enterprise owners for malting purposes. In Kisumu County, Nyando Sub- County was selected purposively since there was vast production of sorghum than other Sub-Counties in the County. Furthermore, majority of the farming households were involved in the higher VC strategic options. In the second stage, two wards (Kobura and Ahero) with the highest number of sorghum farm enterprise owners who were engaged in the higher levels of VC strategic options were selected purposively.

Since the VC strategic options were heterogeneous, farm enterprise owners engaged in the VC strategic options were grouped into homogenous sub-groups (strata) using stratified random sampling. Then, proportionate sampling was used to obtain the total sample size for each stratum and systematic random sampling was used to select the third number from the starting point to be included in the sample to guarantee a representation of sorghum farm enterprise owners from each of the selected wards. The sampling frame was obtained from Ministry of Agriculture, Nyando Sub-County. A total sample of 274 farm enterprise owners were selected from the population of the small-scale farm enterprises owners in the county.

Table 1: Distribution of sample size

Vertical coordination strategic options	Population size	Proportionate	Sample size	Ahero	Kobura
Contractor's option	713	0.82	225	112	113
Processor's option	157	0.18	49	25	24
Total	870	1	274	137	137

3.5 Data Collection and Analysis

Data was collected through personal interviews with the household head. A semi-structured questionnaire was used to collect both qualitative and quantitative data. The questionnaire had both open and close-ended questions. The questionnaire covered information on socio-economic characteristics of the household head, transaction costs factors, institutional factors, drivers of side-selling, targeted VC strategic options and alternative vertical coordination strategic options. The questionnaires were administered by trained enumerators after pre-testing the tool to ensure that the instrument was suitable and reliable to obtain quality data. After data collection, STATA software version 15 was used for data processing and analysis.

3.6 Analytical Framework

3.6.1 Institutional Arrangements of Different Vertical Coordination Strategic Options

To obtain the characteristics of the institutional arrangements in the County, descriptive statistics such as mean, percentage, mode and frequency in the form of Tables and bar charts were used. This described and compared the coordination actors, contract forms and specifications, ex-ante and ex-post control, information shared, monitoring and enforcement mechanisms and human behaviours.

3.6.2 Institutional arrangements on the Choice of the Vertical Coordination Strategic Options

Multivariate probit model was used to determine the effects of institutional arrangements on the choice of VC strategic options since the households sampled selected more than one strategic option simultaneously. The model permits for simultaneous choices bearing for situations where farm enterprise owners concurrently use more than one VC

strategic option (Baskaran *et al*., 2013). The multinomial logistic model stood to be the most appropriate model to estimate the nominal effects of unordered categories (Wooldridge, 2008). But this model would be appropriate when individuals only chose a single outcome from the established set of mutually- exclusive alternatives. In addition, it assumes independence of each choice hence does not allow for substitution or correlation between them.

Therefore, VC strategic option choices were not mutually exclusive allowing for the probability of concurrent choices of VC strategic options and the possibility of correlations among the different VC strategic option choice decisions. Thus, the use of the multivariate model allowed for concurrent correlation in the choice to access different VC strategic options simultaneously. A farmer's choice to select a VC strategic option or not was grounded in the context of utility (Tarekegn & Tegegne, 2017). In this case, we assumed the farm enterprise owners decided to sell their sorghum after assessing the institutional arrangements and utility associated with the given vertical coordination strategic options. The benefit a farmer obtains from the coordination mechanism was the latent variable from the observed explanatory variable and the error term.

The gain the farmer gets from the coordination mechanism was a latent variable determined by observed explanatory variable (Xi) and the error term which represent an observed utility ε_i

$$\gamma_{ik}^{*} = \beta_k \chi_{ik} + \varepsilon_i (\kappa = \gamma_1, \gamma_2, \gamma_3) \quad \ldots\ldots 3$$

Here β_k was the coefficient of the parameter reflecting the impact of the change of the explanatory variable χ_{ik} entailed the explanatory variables such as socioeconomic factors, institutional arrangement and institutional factors. ε_i signified the random errors dispersed by the multivariate normal distribution. κ symbolized the varied levels of utility obtained from the dissimilar strategic options (γ_i). By use of indicator function, the unseen preferences in equation (2) were converted into the observed binary effect equation for all the choices as follows:

$$\gamma_{ik} = \begin{cases} 1 if\ \gamma_{ik}^{*} \rangle 0 \\ 0\ otherwise \end{cases} \quad (\kappa = \gamma_1, \gamma_2, \gamma_3) \quad \ldots\ldots 4$$

γ_{i1} = 1, if farmers opted for other alternative markets such as spot market, 0 otherwise, γ_{i2} =1, if producers chose contractors, 0 otherwise), γ_{i3} =1, if farmers picked processors, 0 otherwise).

Where there was selection of various vertical coordination strategic options, the multivariate probit estimated parameters β_k and the variance-covariance matrix of the multivariate normal distribution (MVN) of the error term (Suhaimi *et al*., 2017). Ω were random errors spread as a multivariate normal distribution with zero conditional mean and variance standardized to unity, where $\varepsilon \sim N(0, \Omega)$ and the covariance matrix Ω was given by;

$$\Omega = \begin{bmatrix} 1 & P_{y1y2} & P_{y1y3} \\ P_{y2y1} & 1 & P_{y2y3} \\ P_{y3y1} & P_{y3y2} & 1 \end{bmatrix} \quad \text{.....5}$$

Table 2: Variables used in the Multivariate probit model

Variable	Description	Measurement	Sign
Dependent variable			
VCSO	Vertical coordination strategic options		
Independent variable			
Farmer characteristics			
Age	Age of the household head in years	Continuous	+
Gender	Gender of the household head	Dummy	+/-
Years of schooling	Education in years of household head	Continuous	+
Other form of income	Off- farm employment	Dummy	+
Years in sorghum production	Sorghum farming experience in years	Continuous	+
Farm characteristics			
Household size	Household size(adult equivalent)	Continuous	+
Land owned and rented	Farm size of the household in acres	Continuous	+
Farm specialization	Size of land under sorghum (ratio)	Continuous	+
Information related costs			
Price expectation	Price close to farmers' expectation	Dummy	+
Is sorghum graded	Quality inspection before selling	Dummy	+/-
Negotiation and transport related costs			
Payment agreement	Number of days to be paid	Continuous	+
Level of bargaining	Level of bargaining with the target buyer (PA, LB, MB, NE,EB)	5 likert scale	+/-
Arranges for transportation	Who arranges for transportation (farm enterprise owners, buyers or both)	3 categories	+
Monitoring related costs			
Uncertain of grade	If uncertain of the sorghum quality after delivery	Dummy	+/-
Buyer supports in ext	Does buyer supports you with services (SD to SA)	5 likert scale	+
Trust	Affective and cognitive (SD to SA)	5 likert scale	+
Institutional factors			
Credit	Access to finance	Dummy	+

3.6.3 Extent of Side-selling Along Vertical Coordination Strategic Options

To achieve this objective, the fractional response model was used. This is because the extent of side-selling was measured as a percentage of the marketed surplus which was a proportion of the total amount of the marketed produce. The values of the dependent variable ranged between 0 and 1. Ordinary Least Squares would have been used to estimate the proportional dependent variable but the bounded explained variable would exhibit inconsistent slopes in the explanatory variables also, the linear models produce predictions outside the interval. Other models that could have been used to estimate bounded dependent variables were truncated and censored regressions such as Tobit but, the values in the interval would not be feasible since the values would not be censored (Baum, 2008).

Fractional response model (FRM) is an extension of generalized linear models (GLM) and other conventional models used to estimate for the bounded dependent variable. The model accounts for the nature of a continuous and bounded dependent variable, predicts values within the limit of the dependent variable interval and produces a good fit for linear models by capturing the non-linearity effect (Gallani *et al*., 2015).

The conditional prospect for the fractional response model is inscribed as;

$$E(\gamma_i / x_i) = G(x_i\theta), i = 1,2,.....N \quad \text{.....6}$$

Whereby γ_i is the dependent variable and χ_i are the exogenous explanatory variables and G is a cumulative distribution function obtained using non-linear methods particularly the quasi- maximum likelihood method(QML) grounded on the Bernoulli log- like function, given as;

$$LL_i(\theta) = \gamma_i \log[G(x_i\theta)] + (1-\gamma_i)[1-G(x_i\theta)] \quad \text{.....7}$$

The Bernoulli function is an affiliate of a linear exponential family (LEF), an estimator of QML denoted as θ defined as;

$$\theta = \arg_\theta \max \sum_{n=1}^{N} LL_i(\theta) \quad \text{.....8}$$

Table 3: Variables used in Fractional Response Model

Variable	Description	Measurements	Expected sign
Dependent variable			
Proportion	Percentage of the marketed surplus	Continuous	
Independent variable			
Farmer characteristics			
Age	Age of household head in years	Continuous	-
Gender	Gender of the household head	Dummy	+/-
Years in sorghum production	Sorghum farming experience in years	Continuous	-
Years of schooling	Formal education in years	Continuous	-
Other form of income	Off-farm employment	Dummy	-
Farm characteristics			
Land owned and rented	Farm size of the household in acres	Continuous	-
Kms to collection point	Distance to sorghum collection point in kms/mins	Continuous	+/-
Economic motivations			
Better prices	Higher prices from alternative markets	Dummy	+
Payment delay	Number of days to be paid	Continuous	+
Level of bargaining	Negotiations on prices and quality	Dummy	-
Credit	Credit access	Dummy	+
Easetoget alternative mrkts	Easiness to access alternative markets (easy, fair or difficult)	3 categories	+
Institutional factors			
Trust	Affective and cognitive trust (SD to SA)	5 likert scale	+
Contactsin2019	Frequency in trainings per year	Continuous	-
Network externalities	Relational networks between farmers and peers (SD to SA)	5 likert scale	
a_1inaradiusofakm (neighbourhood)	Number of farmers in the radius of half a kilometer growing sorghum	Continuous	+
Contract implementation	Enforcement level of the target market (range from 0 to 100%)	Continuous	-

CHAPTER FOUR

RESULTS AND DISCUSSION

This section presents results and discussions, and it is divided into two sections. The first section discusses descriptive statistics entailing of contract designs, institutional arrangements and farmer, farm and institutional factors. The second section presents the econometric results of Multivariate Probit and Fractional Response Model. The descriptive results show that 69.1% of the sorghum producers targeted contractors while 30.9% targeted processors. In the study, contractors constituted of sorghum aggregators and Obuso cooperative in Kobura ward while the processors entailed a brewing company, East African Breweries Limited (EABL) and micro-processors in baking industry.

4.1.0 Descriptive statistics

From Table 4, the mean age of the sorghum producers for the whole sample was 47.83 while for the contractor's and processor's category was 46.94 and 47.83 respectively. The age of the household head was significantly different at 10% level among the groups. The statistics indicated that, majority of the farmers in the region were young and fell within productive age of 35 to 55 years. According to Dlamini and Ortmann (2019) and Maspaitella *et al*. (2018) younger producers are open, innovative and risk takers attempting them utilize the different VC strategic options.

The mean differences of household sizes are presented in Table 4 below. The average household members in each household was 3.32, contractor's had 3.23 while 3.59 for the processor's. The difference was statistically significant at 10%. Household size has often been used as an indicator of farm labour availability and from the results a larger household size is an important input during production, harvesting and transportation influencing choice of VC strategic options (Amare *et al*., 2019; Cheelo, 2019). Alternatively, the larger household size has a higher need for food rendering household heads to be risk averse thus targeting the VC strategic options (Hagos *et al.*, 2020).

The average acres owned by the sorghum producers were 5.08 while those targeting contractors and processors had 4.63 and 6.36 acres respectively. The mean difference of the sizes of land was statistically significant at 1% across the groups. The smaller farm sizes increases the managing ability of the household heads thus opting for new innovative ways of managing the produce thus opting to utilize the different VC strategic options. Abate *et al*. (2019) indicated that as the size of land decreases, the managing ability increases in regard to technology increasing the farmer's technical efficiency.

Table 4: Farmer, farm and institutional characteristics

Variables	Targeted vertical coordination strategic options					
	Contractor		Processor		Overall mean	t-values
	Mean	Std Error	Mean	Std Error		
Age (years)	46.94	1.03	50.36	1.60	47.83	-1.73*
Education (years)	9.64	0.27	9.69	0.50	9.65	-0.10
Household size	3.23	0.11	3.59	0.20	3.32	-1.70*
Sorghum farming experience (years)	5.55	0.35	6.28	0.65	5.74	-1.04
Land size (acres)	4.63	0.24	6.36	0.63	5.08	-3.12***
Amount borrowed(Shs)	17078.43	1082.03	24125	3216.98	17590.91	-1.77*
Extension (Contacts)	5.26	0.35	6.17	0.24	5.57	-1.76*
Distance to extension (Kms)	7.04	0.60	5.51	0.36	6.64	1.48
Distance to collection Point (Kms)	4.20	0.32	5.72	0.71	4.59	-2.20**
Neighbourhood effect	3.65	0.12	3.68	0.21	3.65	-0.13

*, ** and *** denote 10%, 5% and 1% statistical significance levels.

The average amount of credit the sampled producers received was Ksh.17, 590.91 while that of contractors was 17, 078.43 and processors 24, 125. The mean differences of the amount borrowed for the contractors and processors category was statistically significant at 10%. Amount of credit influences sorghum producers to participate in better markets by easing the liquidity problems of households. This further contributes to the choice of markets and capital base allowing them to acquire the specified quality inputs for sorghum production so as to meet the stringent qualities specified by the target buyers. Dlamini and Ortmann (2019), Jebesa (2019) and Tura and Hamo (2018), reported that, credit reduces financial related issues enabling households to invest in purchase of improved seeds, fertilizer and technologies which in turn will enable farm enterprise owners to produce and supply enough surplus of appropriate quality to targeted markets.

From the results, contractor's category had a mean of 5.26 contacts with extension field officers, processors category had 6.17 while the average mean number of extension

contacts for the whole sample stood at 5.57. It is noticeable that the sorghum producers in the study area received adequate extension services and the mean difference showed a statistical significance at 10%. Access to technical services eases the spreading of new information and knowledge to the sorghum producers. Besides, extension services have a positive impact on the choice of VC strategic options as farmers acquire knowledge and skills in marketing (Jebesa, 2019). Maestre (2017) also stated that, trainings and extension services increases access to markets by 58.5% in terms of price, produce quantity and quality.

The average distance to the collection point for the whole sample was 4.59 kilometres as compared to 4.20 and 5.72 kilometres for contractors and processors respectively. The summary statistics shows that there were significance differences in the mean distance to collection point across the two groups at 5%. Households close to a collection point tend to sell sorghum to the collection point thus targeting the markets closer to them. Alternatively, longer distances hinder business transactions and coordination mechanisms heightening moral hazard behaviours of producers. This result is consistent with previous studies by Abate *et al.* (2019)**,** Getahun (2018) and Negi *et al*. (2018) who argued that smallholder farmers situated far from the collection point are less likely to deliver their produce to those markets due to higher transaction costs.

Results in Table 5 shows that, majority (86.86%) of the sampled respondents belonged to a group while 13.14% did not. For those were targeting contractors, 82.7% were in groups and 17.2% were not while those for processors were 98.6% and 1.41% were not. The chi- square result reveals that the proportion of the two differences was significant at 1%. This indicates that most of the sorghum producers were in a group which helped them to transact their produce on behalf of the individual farmer. As a result, they are able to increase their bargaining power and necessitate them to acquire agronomic practices, marketing information and post- harvest handling and storage. According to Murimi *et al*. (2017), activities of production and marketing in a group are recommended to ease challenges associated with embryonic institutions in unindustrialized countries. As well, group membership increases access to knowledge and information on production and marketing influencing the choice of different VC strategic options (Jebesa, 2019).

Table 5: Categorical variables for individual, household and institutional factors

Variable	Description	Contractor		Processor		Overall %	Chi^2-values
		Freq	Percent	Freq	Percent		
Gender	Male	120	59.11	36	50.70	56.93	1.52
	Female	83	40.89	35	49.30	43.07	
Off-farm income	No	101	49.75	32	45.07	48.54	0.46
	Yes	102	50.25	39	54.93	51.46	
Group membership	No	35	17.24	1	1.41	13.14	11.55***
	Yes	168	82.76	70	98.59	86.86	
Access fertilizer	No	75	36.95	7	9.86	29.93	18.40***
	Yes	128	63.05	64	90.14	70.07	
Access extension	No	74	36.45	3	4.23	28.10	27.04***
	Yes	129	63.55	68	95.77	71.90	
Access to seeds	No	65	32.20	7	9.86	26.28	13.33**
	Yes	138	67.80	64	90.14	73.72	
Access credit	No	152	74.88	67	94.37	79.93	12.45***
	Yes	51	25.12	4	5.63	20.07	
Total		**203**	**100**	**71**	**100**	**100**	

*, ** and *** denote 10%, 5% and 1% statistical significance levels.

Most of the producers 70.1% of the whole sample accessed fertilizer from their targeted strategic options while 29.9% did not. For producers targeting contractors, 63.1% accessed fertilizer, 37% did not while the processors category had 90.1% who accessed fertilizer while 9.9% did not. Majority of the sorghum producers received fertilizers from their target buyers and the difference in proportion was significant at 1%. Provision of fertilizers by the buyer to the farmers increases the productivity and quality output thus enhancing farmers' livelihood **(**Hung *et al*., 2019)

From the results, 71.9% of the respondents acquired extension services while 28.1% did not. Around 64% of the contractor's category received extension services and 36% did not whereas, 95.8% received in the processors option and 4.2% do not. The difference in the two categories was significantly different at 1%. Access to technical services equips producers with modern technologies which increases the sorghum production therefore increasing the household welfare. Alternatively, it provides information to producers which

enable them to better their decisions regarding markets (Bellemare & Novak, 2017; Kanana, 2019; Maertens & Velde, 2017).

Majority (73.7%) of the sampled respondents had access to certified seeds while 26.28% did not. Among those who were targeting contractors, 67.8% received seeds from their targeted strategic options but 32.2% did not while 90.1% for the processors option received seeds whereas 9.9% did not. This indicates that majority of the producers received quality seeds from their targeted VC strategic options while some sorghum producers opted to obtain the quality seeds from the local dealers. This is because the targeted VC strategic options were considered reliable to supply the certified seed and also the quality of the seed had impacts on volume and price risks **(**Abebe *et al*., 2013).

Table 5 shows that only 20% of the respondents received credit from their targeted VC strategic options while 80% did not. In the contractors' category, 25.1% of the producers obtained credit while 74.9% did not. In the processors' category, a similar case was observed whereby, only 5.6% obtained credit against 94.4%. The result indicates that the least number of farmers obtain credit and the difference was statistically significant at 1%. This implies that sorghum producers used up their own resources for agricultural activities. Similar results were found by Adu (2018), Bijman *et al.* (2020) and Kanana (2019).

Table 6: Institutional arrangements of the targeted vertical coordination strategic options

Institutional arrangements	Descriptions	Vertical coordination strategic options					
		Contractor		Processor		Overall	Chi^2
		Freq	Percent	Freq	Percent	%	Value
Contractual agreement(with buyer)	No	35	17.24	0	0	12.77	14.03***
	Yes	168	82.76	71	100	87.23	
Nature of agreement	No prior	37	18.23	0	0	13.50	16.86***
	Prior oral	4	1.97	0	0	1.46	
	Prior written contracts	162	79.80	71	100	85.04	
Know price prior	No	51	25.12	0	0	18.61	21.92***
	Yes	152	74.88	71	100	81.39	
Price close to expectations	No	45	22.17	6	8.45	18.61	6.53**
	Yes	158	77.83	65	91.55	81.39	
Grading of sorghum	No	22	10.84	0	0	8.03	8.37***
	Yes	181	89.16	71	100	91.97	
Grade certainty	No	63	31.03	4	5.63	24.45	18.37***
	Yes	140	68.97	67	94.37	75.55	
Transportation arrangement	Farm enterprise	0	0	71	100	25.91	274.00***
	Buyer	203	100	0	0	74.09	
	Both	0	0	0	0	0	
Provision of technical services	No	74	36.45	3	4.23	28.10	27.04***
	Yes	129	63.55	68	95.77	71.90	
Access to quality seeds	No	65	32.02	7	9.86	26.28	13.33**
	Yes	138	67.98	64	90.14	73.72	
Access to fertilizer	No	75	36.95	7	9.86	29.93	18.40***
	Yes	128	63.05	64	90.14	70.07	

Access to credit	No	152	74.88	67	94.37	79.93	12.45***
	Yes	51	25.12	4	5.63	20.07	
Trust their buyers	No	35	17.24	3	4.23	13.87	7.46***
	Yes	168	82.76	68	95.77	86.13	

*, ** and *** denote 10%, 5% and 1% statistical significance levels.

The two targeted VC strategic options stated above differed in terms of contract forms, provisions and specifications making them to vary markedly amongst themselves. In reference to Table 6, the average percentage of the sampled producers who had contractual agreement with buyers was about 87% while those that had no contractual agreement stood at around 13%. Among the producers who had targeted contractors, approximately 82% had contractual agreement and about 17% had none while those who had targeted processors, all the 71 farmers had contractual agreement. This implies that most producers in the study area had a market arrangement with their target buyers thus coordinating their production and marketing activities. This is in line with Schipmann and Qaim (2011) who found out that the sweet pepper farmers had long term binding arrangement with the buyers.

The respondents who had prior written contracts with targeted strategic options were approximately 81% while around 1% had prior oral agreements whereas about 14% had no prior agreement. For those who were targeting contractors, 79.80% had prior written contracts, 2% had prior oral agreement and 18% had no prior agreements. However, all the producers who were targeting processors had written prior agreements with the buyers. This indicates that most farmers preferred written contracts over other modes of agreement and the difference was statistically significant at 1% significance level. This could be because, prior written contracts are used as security for crop financing from financial institutions. Kanana (2019) argued that producers preferred written contracts as they are specific on the roles and responsibilities of each party. Alternatively, Bijman *et al*. (2020) found consistent results stating that written contracts provide opportunities for legal reparation in case the buyer does not comply with the agreed terms.

The average percentage of the producers who had prior price agreement for the sampled respondents was 81.4% in contrast to 18.6% with no price agreement. For those producers who had targeted contractors, 75% had prior price agreement while 25% had no prior price agreement. Among those who targeted processors, all the producers had price agreement with the buyers and thus knew sorghum prices before production. These results in Table 4.3 indicates that the difference in proportion of those who had prior price agreement across the two targeted VC strategic options was significant at 1%. This suggests that by

having a fixed price before production the production and market risks and uncertainties have been reduced encouraging farmers to invest more on their farms increasing their production and incomes (Abebe *et al*., 2013).

The percentage of farmers whose sorghum prices were closer to their expectations and needs in the sampled household was around 81% while 19% were not. For farm enterprise owners targeting contractors, 78% of the producers were satisfied with the price while 22% were not. In the processors' group, 91.5% were satisfied with the sorghum prices while 8.5% were not. Price close to expectations was statistically significant at 5%. Most of the sorghum producers in the study area were offered prices which were close to their expectations as they had fixed prices. According to Abebe *et al*. (2013) fixed price takes account of price expectations shifting risk to the buyer motivating producers to target different VC strategic options.

Majority of the producers' sorghum was graded before purchase. This is evident from the results in Table 6 whereby, 92% of the sampled farmers had their sorghum graded while 8% were not. In the contractors' category, the proportion of the farmers whose sorghum was graded was 89% while 11% was not. Conversely, all the producers who were targeting a processor had their sorghum graded before purchase. The chi-square results depict that grading of sorghum was statistically significant at 1% level. The grading before purchase was vital to protect produce against humidity, pest and insect damage, rodent damage, foreign matter and unusual smell at the farm level thus meeting the buyer's stringent requirements. The results were similar to that of Bijman *et al*. (2020) who found out that agribusiness companies graded produce before purchase as they needed a steady flow of quality products which increases the companies' brand reputation and asset utilization.

From the results, 75.55% of the whole sampled producers were certain of the quality after delivery while 24.45% were uncertain. About 69% of those who had targeted contractors were certain of the grade and uncertain were around 31%. For the processors, 94.37% were certain of the quality while 5.63% were not and the difference of the proportions was significant at 1%. After grading sorghum at the farm level, the produce is further graded by the processors for aflatoxin, starch levels and humidity. This makes other sorghum producers to be uncertain of the quality of the produce they supplied incase the produce was stored for a while before transportation or if producers' storage facilities were sub-standard. This calls for deductions discouraging producers from supplying their produce to coordinated markets. This finding is consistent to that of Arinloye *et al*. (2015) who found out that 6% of the pineapples supplied were rejected offering the producers lower prices for

the commodity. Adu (2018) also found out that cassavas were rejected for not meeting the stated quality in contracts.

The transportation arrangement was categorized into three, arrangement by farm enterprise owners, buyers or cost sharing (both) but two categories were identified in the study area. From the whole sample, 25.91% arranged for their own transportation to the targeted buyers, while buyers arranged for 74.09% of the respondents. None of those who had targeted contractors arranged for their own transportation as agribusiness aggregators arranged for all the 203 producers. Equally, all the producers in the processors category arranged for their own transportation. The results showed a statistical significant difference in the proportion of transportation arrangement across the two targeted vertical coordination strategic options at 1%.

This indicates that all the producers who were targeting processors arranged for their own transportation while those who targeted contractors were arranged for. Transportation arrangement influenced the choice of VC strategic options. This finding is in line with that of Bijman *et al*. (2020) whose producers were provided transport by the agribusiness companies at a cost. This lowers the transportation costs of the small-scale producers thus motivating them to choose different VC strategic options (Abate *et al.*, 2019; Getahun, 2018; Negi *et al*., 2018).

Above 71% of the sampled respondents were provided with technical services by their targeted strategic options but 28.10% did not receive technical services. In the contractor's category, 63.55% received technical services and 36.45% did not while 95.77% of the processor's category received technical services and 4.23% didn't and the difference was statistically significant at 1%. From the results, sorghum producers in the study area received adequate amount of training from their targeted VC strategic options through a project termed as Farm to Market Alliance (FtMA) which aided them to make informed decisions regarding markets (Bellemare & Novak, 2017; Girma & Gardebroek, 2015; Kanana, 2019; Maertens & Velde, 2017).

In April 2019, about 74% of the total number of respondents received quality seeds from the targeted VC strategic options whereas, about 26% did not. Above 67% of the producers targeting contractors obtained quality seeds and 32% did not but about 90% of the processors category received quality seeds and approximately 10% did not. The difference in terms of access to quality seeds was significant at 5%. This shows that most of the sorghum producers received quality seeds from their targeted vertical coordination strategic options. This is because both buyers had placed emphasis on quality of the produce after harvesting

compelling farmers to go for quality seeds from their various VC strategic options in order to meet the quality. The finding was similar to that of Abebe *et al*. (2013) who argued that producers consider buying seeds from their buyers since seed quality has much effect on yield and price risk. It can also allow risk sharing when producing crops with fixed grades. Bijman *et al*. (2020) also found out that agribusiness companies provided full input support to the producers.

The percentage of farmers who accessed fertilizer from their targeted VC strategic options in the whole sample was 70.07% whereas those who had no access to fertilizer were 29.93%. About 63.05% of the contractors' category accessed fertilizer and 36.95% did not. In the processors' category, 90.14% had accessed fertilizer from the buyers while 9.86% did not. The difference between the farmers who accessed fertilizer and those who did not was significant at 1% implying that majority of the producers obtained fertilizers from their buyers through the FtMA project. However, due to the delays experienced in the supply chain, other farmers opted to obtain their quality fertilizers from the local agro vets for timely planting. This was to aid them meet the stipulated quality enhancing their livelihood **(**Bijman *et al*., 2020; Hung Anh *et al*., 2019). In contrast, Abebe *et al*. (2013) argued that producers are risk averse towards input markets since they are missing and imperfect opting to obtain their inputs from the buyers.

From the whole sample, only 20% of the farmers obtained agricultural credit from Musoni microfinance last year while 80% of the producers did not. In the contractors' category, 25.1% of the producers obtained credit while 74.9% did not. In the processors' category, a similar case was observed whereby, only 5.6% obtained credit against 94.4%. The difference is statistically significant at 1%. This indicates that sorghum farmers in the region are able to acquire the stated agricultural inputs without financial assistance from the financial institutions. Additionally, delays in approval and giving out coupled up with high interest rates discourage producers from acquiring loans for their production. Thomas and Vink (2020) also reported that high interest rates, incapacity to pay loans, postponements in the approval and handing out of loan and lack of security hinder farmers from accessing loans.

Majority of the respondents trusted their targeted buyers and from the results, 86% of the sample trusted their targeted buyers while 14% did not. About 83% of those who targeted contractors trusted their buyers, 17% did not while 95.8% of the processors trusted buyers and 4.2% did not. This clearly shows that most of producers trusted their target buyers and the difference was significant at 1%. This is because most of the sorghum producers had

repetitive transactions before with their buyers thus increasing their confidence on the buyers. Trust reduces monitoring costs for buyers thus opting for repetitive transactions with the producers increasing participation in the coordinated strategic options (Ba *et al*., 2019; Bijman *et al*., 2020).

Table 7: Institutional arrangements of the targeted vertical coordination strategic options (continuous variables)

	Targeted vertical coordination strategic options					
Variables	**Contractor**		**Processor**		**Overall**	**t-values**
	Mean	**Std. Error**	**Mean**	**Std.Error**	**mean**	
Information access (days)	3.92	0.07	3.60	0.11	3.84	2.49**
Payment agreement (days)	11.50	0.41	13.76	0.19	12.09	-3.23***
Payment delay(days)	10.59	0.50	13.46	0.48	11.34	-3.20***
Bargaining power (5 likert scale)	1.53	0.07	1.83	0.16	1.61	-2.04**
Distance to target market (Kms)	12.64	0.69	15.77	0.82	13.45	-2.49**
Extension services (contacts)	5.26	0.35	6.17	0.24	5.57	-1.76*

*, ** and *** denote 10%, 5% and 1% statistical significance levels.

Table 7 presents the institutional arrangements of the targeted vertical coordination strategic options by small-scale sorghum producers in April 2019. In easiness of getting information, the contractor side had a mean of 3.92, processors had 3.60 and the overall mean was at 3.84. There was a statistical difference in the information access mean across the two categories at 5% thus indicating that farmers could moderately access production and market information from FtMA project. Information sharing enables producers to get better opportunities with buyers at a lower negotiation cost thus participating in higher VC strategic options (Ba *et al*. 2019; Otsuka *et al*., 2016).

Producers in the targeted VC strategic options had agreements before production either orally, written or through repetitive transactions. From all the respondents sampled, the mean days agreed upon for them to receive their payments was around 12 days while

producers targeting contractors was 11.50 whereas those targeting processors was at 13.76. However, contractor's category were paid after 10.59 days while the processors category received their payment after 13.46 days and the overall mean of delay stood at 11.34. The mean difference between the payment agreements was significantly at 1%. This indicates that both producers targeting different VC strategic options received their payments as per the stated agreement during production period. This delay influences the choice of VC strategic options of producers (Adu, 2018; Siddique, 2015).

The average mean of bargaining power for the sorghum producers was 1.61, 1.53 and 1.83 for the whole sampled respondents, contractors' category and processors' category. The results show that the producers had little bargaining power in the two categories and the difference had significance at 5%. The little bargaining power observed in the targeted VC strategic options was because the prices were normally fixed and addressed before production and thus all were "price takers". This finding is consistent with that of Thomas and Vink (2020) who stated that horticultural prices depended on the bargaining behaviors of traders and market power. Alternatively, Ba *et al*. (2019) reported that when bargaining power of producers is strengthened, they are willing to participate in coordinated markets.

Regarding the distance to the target market, the mean distance for contractors was 12.64, processors 15.77 and on average was 13.45 kilometers. This shows that the difference between the distances to the target market in the two category was significant at 5%. Proximity to target markets reduces transaction costs related to transportation costs and also facilitates in decision making on the choice of the VC strategic options that are accessible to them with ease (Murimi *et al*., 2017; Ramly, 2018).

The number of contacts with extension services was used as a proxy for specificity in human asset which involves skills attained after being trained on sorghum production. Averagely, the respondents had 5.57 contacts whereby contractor's category had 5.26 and processor's option had 6.17 and the difference was statistically significant at 10%. It is thus evident that the producers had adequate human capital which enhanced them to make effective production and marketing decisions. This is in line with Addis *et al.* (2019) and Smith *et al*. (2017) who found a relationship between number of contacts with extension agents and marketing channels.

4.1.1 Sources of information

Sorghum producers in the study area received market information from several channels such as NGO, buyers, media and social media, other farmers, seminars, Ministry of Agriculture and social forums such as chief Barasa, churches, funerals and marketplaces. The proportion of respondents who received the market information from other farmers were 69%, NGOs were 64%, buyers 51%, media and social media 51%, seminars 8%, social forums 4% and Ministry of Agriculture at 1% while those who did not receive the market information from the various channels were 31%, 36.1%, 48.5%,48.9%, 91.6%, 96%, and 99.3% respectively. The differences in the proportion of producers who acquired market information from NGOs, Buyers and social forums were significant at 1% in at Table 8 below.

Table 8: Source of information

Source of information	**Description**	**Contractor**		**Processor**		**Overall %**	**Chi2-values**
		Freq	**Percent**	**Freq**	**Percent**		
Other farmers	No	67	33.00	18	25.35	31.02	1.44
	Yes	136	67.00	53	74.65	68.98	
NGOs	No	89	43.84	10	14.08	36.13	20.19***
	Yes	114	56.16	61	85.92	63.87	
Buyers	No	133	65.52	0	0.00	48.54	90.40***
	Yes	70	34.48	71	100.00	51.46	
Media and S.media	No	99	48.77	35	49.30	48.91	0.01
	Yes	104	51.23	36	50.70	51.09	
Seminars	No	186	91.63	65	91.55	91.61	0.00
	Yes	17	8.37	6	8.45	8.39	
Social forums	No	199	98.03	64	90.14	95.99	8.50***
	Yes	4	1.97	7	9.86	4.01	
MOA	No	202	99.51	70	98.59	99.27	0.61
	Yes	1	0.49	1	1.41	0.73	
Total		**203**	**100**	**71**	**100**	**100**	

*, ** and *** denote 10%, 5% and 1% statistical significance levels

This indicates that the sorghum farmers received adequate amount of market information from NGOs, Buyers (contractors and processors), Media and social media and also from other farmers. The channels informed producers on market conditions thus helping sorghum producers to choose a specific strategic option to which they will sell their sorghum to before the start of the production period. Adequate market information access prevents adverse selection and moral hazard which reduces transaction costs and encourages producers to participate in high end markets (Jebesa, 2019).

4.1.2 Factor analysis for network externalities, behavioural uncertainty and trust

According to Coulibaly *et al*. (2018), Confirmatory Factor Analysis (CFA) is usually used where multiple likert items are recommended for latent constructs such as opinions and perceptions. In this study, the unobservable paradigms were used to determine the perception on network externalities, behavioural uncertainties and trust. The factor analysis tests were performed to determine Kaiser- Meyer- Olkin, Composite Reliability, Factor loadings and Average Variance Extracted.

As presented in Table 9, network externalities was an institutional factor which had eight likert items and each item was in 5 Likert scale stretching from strongly disagree to strongly agree. The variable was analyzed using confirmatory factor analysis. Kaiser-Meyer-Olkin was evaluated to determine the adequacy of the data collected for CFA and the value obtained was 0.74 suggesting that the sample size was appropriate and adequate for CFA (Coulibaly *et al*., 2018; Friel, 2017). The Composite Reliability (CR) determines the convergence of the constructs in terms of reliability and validity and in the study, network externalities had a CR of 0.70 indicating that the constructs were valid and reliable (Coulibaly *et al*., 2018; Garson, 2016). The value of Average Variance Extracted for network externalities was at 0.51.

For behavioural uncertainty, the KMO was 0.5 and the composite reliability was 0.55, they all fell at the recommended value of 0.5 (Coulibaly *et al*., 2018; Garson, 2016). Also, the average variance extracted was 0.35. The weak AVE was remedied by its CR which is at the recommended mark. Trust was a monitoring related cost and had three Likert items. Trust had a KMO of 0.67, CR of 0.76 and AVE of 0.902. All the tests were high indicating validity of the constructs as shown in Table 9 below.

Table 9: Confirmatory Factor Analysis (CFA) on network externalities, behavioural uncertainty and trust

Variable	Items	Factor Loading	CR	AVE	KMO
Network externalities (Adams *et al*., 2017)	Those whom I associate most with, think we should participate in commercialization of sorghum	0.710	0.698	0.508	0.737
	Family members think I should participate in commercialization of sorghum	0.371			
	My relatives think I should participate in commercialization of sorghum	0.458			
	My friends think I should participate in commercialization of sorghum	0.593			
	Important people to me think I should participate in commercialization of sorghum	0.275			
	People influence my behaviour think should participate in commercialization of sorghum	0.644			
	My fellow workers think I should participate in commercialization of sorghum	0.695			
	My peers at my workplace think I should participate in commercialization of sorghum	0.693			
Behavioural uncertainty (Hao *et al*., 2018)	I have no clue about the prices I will be offered by my target buyer before hand	0.006	0.545	0.352	0.490
	I do not know the quality	0.058			

	requirements of my target buyer before hand				
	I incurred loss due to decisions that were made without consulting	0.9034			
	I experienced loss as a result of delayed payments by my target buyer	0.909			
Trust (Djalalou-Dine *et al*., (2012)	My target buyer keeps frequent contacts and interaction with me	0.754	0.759	0.902	0.666
	My instincts tells me that my target buyer can be truthful and trusted	0.863			
	I do obey the rules set with my target buyer	0.865			

A weighted mean was obtained to get the average scores of farm enterprise owner's perceptions on network externalities, behavioural uncertainty and trust. Grounded on Coulibaly *et al*. (2018)'s work, the mean was denoted as Extremely Strong with an average score of 4.21-5.00, Very Strong had 3.41-4.20, Strong had 2.61-3.40, Somewhat Strong had 1.81-2.60, and Not Strong had 1.00-1.80. The weighted scores are as shown in Table 4.7.

Table 10: Average scores of producers' perceptions on network externalities, behavioural uncertainty and trust

Variable	Contractor (N=205)	Processor (N=69)	t-values
Network externalities	3.47	3.57	-0.83
Behavioural uncertainty	2.39	2.46	-0.59
Trust	3.59	3.61	-0.12

Regarding, Table 10, the producer's perception on network externalities had no significant difference at 10%. The sorghum producers who were targeting contractors had a weighted mean of 3.47 while that of processors stood at 3.57. This shows that the two means fell at the 'very strong' category which ranged from 3.41 to 4.20. It indicates that the network externalities of the farmers had strong influence on the choice of the targeted VC strategic options.

Behavioural uncertainty is a risk variable associated with decisions made by the buyer firm without consulting, uncertainty on prices and quality requirements and delayed payment.

The risk attitude of farm enterprise owners influences their decisions on choice of VC strategic options. Farm enterprise owners' perception on behavioural uncertainty had a scale of 2.39 and 2.46 for contractor and processor respectively inferring 'somewhat strong' for the two categories. Processors category had higher behavioural uncertainty than contractors and these uncertainties have an impact on the choice of the VC strategic options. The t-test results had no significant differences at 10%.

Farmers' attitude on trust had weighted mean score of 3.59 for contractors and 3.61 for processor's category. This signifies "very strong" trust towards the targeted VC strategic options. Trust encourages producers and buyers to have relationship-specific investments which in return increases productivity of the household since opportunism has been reduced and also little time is spent on screening on transacting partners and payment follow ups lowering transaction costs on information related and monitoring costs (Hailu, 2016). This indicates that trust plays a significant role on the choice of VC strategic options. From the results, the processor's trust is higher than the contractor's category and the mean differences between the two categories were not significant at 10%.

4.2.0 Effects of social economic and institutional arrangements on the choice of vertical coordination strategic options

This section presents econometric results on effects of social economic and institutional arrangements on the choice of vertical coordination strategic options. Diagnostic tests were determined before analysis to detect statistical hitches of multicollinearity and heteroskedasticity. All the independent variables were subjected to this test.

4.2.1 Diagnostic test of the variables used in the econometric analysis

This section presents diagnostic tests for the variables used in the econometric analysis of the study. It diagnoses statistical hitches of multicollinearity and heteroskedasticity for farmer and farm characteristics, institutional, information cost, negotiation cost and monitoring cost variables. Multicollinearity constitutes of inter-associations and inter-correlations of the proposed continuous independent variables which can results to incorrect inferential estimates and conclusion. Variance Inflation Factor (VIF) was used to test for the explanatory variables as shown in Table 11. The results showed that there was no serious linear relationship among the tested continuous explanatory variables since VIF values were less than 10.

Also for categorical variables, contingent coefficients were estimated to determine multicollinearity and results are presented in Table 12. The results also confirmed that there

was no serious linear relationship among the categorical explanatory variables because contingent coefficients were less than 0.75 in all cases (Shin & McCann, 2018). Based on the tests done, there was no strong association among all hypothesized explanatory variables. Therefore, all of the proposed potential explanatory variables were used in regression analysis.

Table 11: VIF results for continuous variables

Variable	VIF	1/VIF
Behavioural uncertainty	2.16	0.4620
Enforcement level	2.08	0.4814
Network externalities	1.68	0.5950
Contacts by extension officers	1.68	0.5966
Age of household head	1.67	0.5980
Farm specialization	1.62	0.6167
Easiness of market information	1.55	0.6456
Buyer support in extension delivery	1.54	0.6474
Trust	1.54	0.6484
Years of schooling	1.54	0.6988
Distance to extension provider	1.52	0.6559
Neighbourhood effect	1.45	0.6905
Sorghum farming experience	1.43	0.6974
Distance to collection point	1.43	0.7012
Household size	1.35	0.7417
Effect of climate change	1.35	0.7424
Payment agreement	1.34	0.7477
Level of bargaining power	1.34	0.7482
Land owned and rented	1.33	0.7493
Mean VIF	**1.56**	

Table 12 Contingency coefficient test for categorical variables

	Gender	Off-farm	Price expectation	Alternative market	Quality inspection	Grade uncertainty	Credit	Transportation effort
Gender	1.0000							
Off-farm	0.0188	1.0000						
Price expectation	0.0751	0.0421	1.0000					
Alternative market	0.0323	-0.1025	0.0224	1.0000				
Quality inspection	0.0129	0.0086	0.1002	0.1263	1.0000			
Grade uncertainty	0.0318	0.1780	0.1424	0.0871	0.4569	1.0000		
Credit	-0.1230	0.0492	0.2397	-0.1173	0.1481	0.0943	1.0000	
Transportation effort	-0.0744	-0.0411	-0.1544	0.0900	-0.1747	-0.2589	0.2132	1.0000

All the independent variables were further subjected to heteroskedasticity test using white test as shown in Table 13. This method was considered to Breusch- Pagan test since it accounts for both the direction and magnitude of change (Farbmacher & Kogel, 2017). The result shows no problems with heteroskedasticity as the p-value was greater than 5%.

Table 13 Test for heteroskedasticity

Source	**Chi^2**	**Df**	**P**
Heteroskedasticity	166.26	138	0.0509
Skewness	31.42	21	0.0669
Kurtosis	57.25	1	0.0000
Total	254.93	160	0.0000

Chi2 (138)	= 166.26
Prob>chi2	= 0.0509

4.2.2 Effects of socio-economic and institutional arrangements on the choice of vertical coordination strategic options

Multivariate probit model was used to determine the influence of social economic and institutional arrangements on the choices of vertical coordination strategic options in Kisumu County. The MVP model estimated the vertical coordination strategic options jointly and the error terms of the three equations were significant at 1%. Table 14 shows that decisions of marketing sorghum to the spot market, contractors and processors are made jointly and correlated. It also confirmed that the vertical coordination strategic options were substitutes and one option can be chosen over the other (Dlamini-Mazibuko *et al*., 2019).

Table 14 Correlation Matrix

	Contractor option	Processor option	Spot option
Contractor Option	1.000 (0.06178)		
Processor Option	(-0.25045)	1.000 (-0.24534)	
Spot Option	(1.2372935)**	(-0.84468)	1.000 (0.15289)

Coefficients in parentheses

Table 15 presents the Multivariate Probit Model and the likelihood test ratio (Rho21 = Rho31 = Rho32 = 0) was significant at 1%. The error terms had a normal distribution with a zero conditional mean indicating that the model was a good fit to use since it shows the sorghum farm enterprise owner's decision to sell to different vertical coordination strategic options. Also as shown in Table 4.12, the Wald chi2 [51(188.12) χ =256.62***] was significant at 1% level indicating that the coefficients of the multivariate probit model were conjointly significant and the explanatory factors included were satisfactory (Mohd Suhaimi *et al*., 2017). This indicates that the model was a good fit and inclusion of parameters to the model would improve the model fit.

Table 15: Multivariate probit results on choices of vertical coordination strategic options

Variable	Spot (104)			Contractor (174)			Processor (86)		
	Coeff	dy/dx	Std error	Coeff	dy/dx	Std error	Coeff	dy/dx	Std error
Gender of Household head (dummy)	-0.190	-0.044	0.206	-0.214	-0.050	0.202	0.292	0.068	0.286
Age of Household head (continuous)	-0.024***	-0.006	0.009	-0.006	-0.001	0.008	0.014	0.003	0.011
Education of household head(continuous)	0.050	0.012	0.033	0.030	0.04	0.030	-0.001	-0.000	0.040
Other form of income (dummy)	-0.335	-0.078	0.223	-0.051	-0.012	0.211	0.617**	0.144	0.309
Sorghum experience (continuous)	0.077***	0.018	0.023	-0.015	-0.007	0.218	-0.028	-0.007	0.028
Land owned and rented (continuous)	-0.110***	-0.026	0.035	0.007	0.002	0.026	0.067**	0.016	0.032
Household size (continuous)	0.055	0.013	0.069	-0.111*	-0.026	0.061	-0.092	-0.022	0.083
Farm specialization (ratio)	-0.515	-0.120	0.424	-0.053	-0.012	0.400	0.300	0.069	0.547
Price close to expectations (dummy)	0.989***	0.231	0.365	0.006	0.001	0.286	-0.458	-0.107	0.398
Quality inspection (dummy)	-0.536	-0.030	0.517	1.083**	0.253	0.472	-0.687	-0.160	0.620
Payment delay (continuous)	-0.127***	-0.030	0.033	0.051*	0.012	0.030	-0.116**	-0.027	0.047
Bargaining power (likert)	0.265**	0.062	0.119	0.185*	0.043	0.102	-0.326**	-0.076	0.137
Transport arrangement (dummy)	-0.608**	-0.142	0.268	1.586***	0.370	0.249	-2.528***	-0.590	0.378

Distance to collection point (continuous)	0.070***	0.016	0.019	0.040*	0.009	0.022	-.010	-0.002	0.025
Grade uncertainty (dummy)	0.863***	0.202	0.316	-0.395	-0.092	0.302	0.251	0.059	0.469
Technical support from buyer (likert)	-0.040	-0.009	0.085	-0.173**	-0.040	0.087	0.114	-0.007	0.114
Credit access (dummy)	-0.360	-0.084	0.255	-0.339	-0.079	0.281	-0.151	-0.035	0.481
Cons	1.654		1.008	-2.187**		1.044	3.743***		1.406
Number of observations								274	
Log likelihood								-256.620	
Wald chi2(3)								188.12	
Prob>Chi2								0.0000	
Likelihood ratio test of rho21 = rho31 = rho32 = 0									

, ** and * denote 10%, 5% and 1% statistical significance levels. Likert variables scores Extremely Strong 4.21 to 5.00 Very Strong 3.41-4.20, Strong 2.62-3.40, Somewhat Strong 1.81-2.60 and Not strong 1.00-1.80. For categorical variables, No (1), Yes (2), Male (1), Female (2)*

Age of the household head's coefficient and marginal effects were negative and significant at 1% in choice of spot market had a negative impact of -0.006. The finding implies that an increase in the age of the household head lowers the likelihood of selling to spot by 0.6%. This shows that older farmers are less likely to choose spot market over coordinated options. This is attributed to the fact that younger farmers are risk takers and would like to try out other alternatives even though the contracts in other marketing options prohibit. While, older farmers are risk averse and prefer markets which are secure with minimal risks thus opting for higher vertical coordination strategic options. The finding is in line with that of Ochieng *et al*. (2017) and Zamasiya *et al*. (2014) who found out that older producers are risk averse and also have access to resources which motivate them to be in contracts and other coordinated markets. However, Mohd *et al*. (2017) argued that older farmers have more networks which help them to sell directly to spot markets while younger producers are new and will opt for coordinated options.

Off-farm had a positive and significant coefficient on the choice of processors. Its marginal effect was at 0.617 showing that an increase on off farm income prompts sorghum producers to sell to processors by 61.7%. This indicates that, sorghum producers in a non-farm work are more likely to sell their sorghum to processors. This is because farmers engaged in off farm related activities have less time to look for direct buyers who could purchase their produce on spot and also in managing their farm activities. This finding was in line with that of Hao *et al*. (2018) who stated that producers involved in off farm employment will face high opportunity costs on time spent on negotiating transactions and in obtaining information. Alternatively, Mohd *et al.* (2017) found out that producers involved in off farm employment have less time to look for buyers thus opting to sell their products to dairy industry service centres where their products are readily accepted. Alternatively, producers with better pays are likely to sell to strategic options which focus on quality requirements since they are well endowed and are not constrained by finances (Mugenzi, 2021)

In respect to sorghum farming experience, it had a positive and significant influence on choice of spot markets. Spot market was significant at 1% and had a marginal effect of 0.077 indicating that producers with average and higher years of experience in sorghum farming are likely to choose spot markets over contractors and processors by 7.7%. It could be because, the sorghum producers with experience have more understanding on production and marketing activities exposing them to direct markets with prompt pay thus preferring spot markets over coordinated options. Alternatively, farming experience improves producers' participation in markets as they are exposed to different markets and their

bargaining power thus selling in spot markets. However, the finding is a contrast to Mawardati (2018) who reported that 5.2 years in oil palm farming is not enough to understand the challenges and obstacles in agricultural industry.

Farm size had a negative significance level and a marginal effect of -0.026 on farmer's choice on spot market and a positive effect and marginal effect of 0.016 on processor. For spot market, the significance level was at 1% while for the processor had significance of 5%. This signifies that sorghum producers with larger land size are likely to sell their produce to processors by 1.6% and are less likely to sell to spot markets by 2.6%. This is because, farmers with large land sizes have a potential to produce more volume of sorghum which is ideal to sell directly to processors. Then again, processors prefer contracting large-scale farmers as they are able to meet the stated volumes. The result is consistent with that of Dlamini *et al.* (2019) who find out those producers with larger land sizes are likely to opt for supermarkets than traditional channels. Similarly, Temesgen *et al.* (2017) found out that producers with larger farm sizes select wholesaler outlets over cooperatives and collector outlet. Additionally, Hao *et al*. (2018) reported that an increase in apple land size lessens farmers to sell their apples to wholesalers but when land exceeds 1.27ha, the likelihood of selling to wholesaler's increases.

In the study, the household size had a negative significant effect on producers' choices of contractors and no significant effect on spot markets and processors at 10%. The marginal effect was at -0.111. The result indicates that, larger household size reduces the likelihood of sorghum producers to select contractor's option by 11.1%. This is because the larger households consume more sorghum reducing the marketable surplus and assist each other in selling their sorghum directly to alternative markets. The result is consistent to that of Tura and Hamo (2018) who reported that the household size negatively affected selection of wholesale market but influenced selling to consumer markets. Similarly, Abu *et al.* (2016) suggested that family size has both negative and positive significant effect on selection of vertical coordination strategic options. An increase in the size of household member's increases market participation through cheap labour then again reduces the probability of producers to select multiple markets due to reduced surplus. The study is a contrast to that of Dlamini *et al.* (2019) who found a positive influence of household size on market selection arguing that the larger the family size the larger the labour endowment for production and marketing activities.

Price expectation was significant at 1% and had a positive influence on the selection of spot market over contractors and processors. Its marginal effect was at 0.231 and the

results indicates that, higher prices in alternative markets increases the probability of sorghum producers to sell to spot over coordinated options by 23.1%. This is because, prices are known prior in contracts which force spot markets to price highly in order to attract more produce thus meeting producer's expectations. This finding is in line to that of Kanana (2019) who found that producers prefer variable prices over fixed prices as they feel the fixed prices are always lower.

The coefficient of quality inspection had a positive significant influence on selection of contractors. The significance level was at 5% and its marginal effect at 0.253. It indicates that most of the contractors graded sorghum before purchasing it from producers. This is because the processor EABL is so stringent against quality grades. Contractors provide written contracts which state the quality they need from the producers train the farmers and do checks on the quality before purchase in order to protect their contracts. Those who have not met the stringent qualities will be forced to sell their produce to spot markets for home consumption. This motivates producers to opt for contractor's option by 25.3% as they are trained on production meeting the buyer's needs. This study is in line with that of Hao *et al*. (2018) who found out that wholesalers provide before- hand information on quality grades and prices for each grade in order to ensure adherence to quality. Then during purchase, wholesalers will select apple farmers with comparative high quality.

Payment delay occurs when sorghum producers do not receive prompt payment after the sale of their produce. The delay period in Kisumu County varies greatly across different vertical coordination strategic options. The variable is significant in all the three vertical coordination strategic options indicating that it highly influences the VC strategic options decisions of the sorghum producers. Spot market had a negative significance level of 1%, a positive significance of 10% on contractor's choice and a negative significance at 5% on processor's category. Their marginal effects were at -0.127, 0.012 and -0.027 respectively.

This finding is contrary to our prior expectations that delayed payments would force producers to opt to options with prompt payment. The finding implies that as delay in payment increases the likelihood of sorghum producers to sell to spot market and processors reduces by 12.7% and 2.7% respectively while opt for contractors by 1.2%. The justification is because selling to contractors will benefit them more in terms of bulk purchase and quick process than spot which is only associated with prompt payments. Additionally, the processor's option has more transaction costs related to transportation which will discourage producers owing to prolonged payment. The result is in line with Dlamini *et al*. (2019) who

confirmed that the more the delay, the more the producers are likely to participate in supermarket and NAMBoard channels and less in traditional markets.

The coefficient of bargaining power of the household head had a positive relationship with spot market and contractor at 5% and 10% respectively while that of the processor had a negative relationship at 5%. Their marginal effects were 0.062, 0.043 and -0.076. As the level of the bargaining power of producers increases, the probability of the producers choosing contractor and spot markets increases by 6.2% and 4.3% while the likelihood of sorghum producers selecting processors decreases by 7.6%. This is because during harvesting, there is higher demand of sorghum by aggregators who only surface during harvesting seasons as they want to meet contracted volumes thus offering premium prices to the producers increasing their bargaining power. It is also exhibited in spot market enabling producers to choose the two markets which are economically beneficial to them. These results are similar to that of Emana *et al*. (2015) who found that bargaining power has a negative and significant effect on the choice of collectors, retailers and wholesalers at 1% significance level.

The coefficient for transportation effort is significant for all the VC strategic options at 5% for spot market, 1% for both contractors and processors. However, the sign varied across the vertical coordination strategic options. Spot and processors had a negative sign while contractors had a positive one with marginal effects of -0.142, 0.370 and -0.590. This indicates that transportation arrangement by the buyer motivates sorghum producers to sell their sorghum to contractor by 37% lowering in spot and processors by 14.2% and 59%. This is because distant farmers will opt for contractors aggregating near their homes in order to reduce their transportation costs. Alternatively, some contractors navigate into the interior to get commodities from them. Then again, poor roads discourage producers from transporting their produce to better markets forcing them to sell to farm gate (contractors). The results of this study are consistent with that of Dlamini *et al*. (2019) and Tura and Hamo (2018) who found a negative sign for the supermarket equation since they are situated in urban regions.

Grade uncertainty had a positive significant influence of 1% and a marginal effect of 0.202 on choice of spot market. This shows that producers supplying to spot markets were uncertain about the quality of sorghum they produced unlike in other VC strategic options. Before grading, sorghum produce sold to processors and contractors is not known in terms of quality since they only check on impunities and moisture content leaving out aflatoxin and starch content. This puts farmers to risks as payment is received based on the final grade of the produce. Grade uncertainty forces farmers to incline towards spot market and less of contractors and processors. This study is similar to that of Innocent *et al*. (2018) who found

out that milk quality influenced choice of markets positively. It increases dairy farmers to choose milk collection centers over brokers. Farmers who were unaware of the quality of milk encountered lower prices and even rejection of milk by milk collection centres.

The extent of technical services delivered by the buyer had a negative coefficient for contractors at 5% and a marginal effect of -0.040. This reflects that availability of technical support lessened sorghum producers from choosing contractors by 4%. This is because contractors mainly offered extension services to the producers and in return, the support is factored in the final price discouraging farmers from selling to the option. The finding contrasts with that of Mukarumbwa *et al*. (2017) who stated that producers are expected to double their involvement in urban markets if marketing information is made available to them. This is because marketing information helps them to align their production and marketing activities as production increases. Also, Dlamini *et al*. (2019) found that producers who had access to extension delivery were likely to select traditional and National Marketing Board channels and less likely to supermarkets. Other studies (Abu *et al*., 2016; Bindu & Chigusiwa, 2013; Sebatta *et al*. 2014) found that support in technical services improves market participation as it improves producers' skills and knowledge.

4.3 Extent of side selling among the small-scale sorghum farm enterprise owners along the vertical coordination strategic options

The extent of side selling among small-scale sorghum farm enterprise owners along the different vertical coordination strategic options was achieved using Fractional Response Model. Table 16 shows results of diagnostic statistics and the Wald chi-square (-31.20) was significant at 1% level. It suggests that the independent variables in fractional response model jointly had an influence on producer's decision to side sell or not to side sell their produce. The Pseudo R^2 was 0.709 indicating that the model used predicts about 71% of side selling behaviour of sorghum producers thus considered fit for estimation. The constant showed a positive significant effect.

This result suggests that at *ceteris paribus*, majority of the sorghum enterprises side-sold some of their produce to alternative markets. Ten against eighteen coefficients of the variables showed statistical significance of at least 10% thus indicating that most small-scale farm enterprise owner's side sold some of their produce to other strategic options. These significant variables were experience in sorghum production in years, other forms of income, land size (land owned and rented), better prices, credit access, neighbourhood effect, technical services (contacts), level bargaining power, network externalities and trust. The

study used marginal effects instead of coefficients to determine the strength of the independent variable on dependent variable. The marginal effects were calculated and presented in Table 16.

Table 16: Extent of side selling

Variable	Coefficient	Marginal Effects dy/dx	Robust standard error
Farmer characteristics			
Gender of household head (dummy)	-0.297	-0.013	0.601
Age of household head (continuous)	-0.049	-0.002	0.033
Education of household head (continuous)	-0.012	-0.001	0.119
Years in sorghum production (continuous)	0.242***	0.011	0.077
Other form of income	-1.988***	-0.089	0.729
Farm characteristics			
Land owned and rented(continuous)	-0.101*	-0.005	0.057
Distance to collection point (continuous)	0.045	0.002	0.039
Economic motivations			
Better prices (dummy)	7.900***	0.355	1.912
Time one received payment (continuous)	-0.187	-0.008	0.117
Ease to get alternative markets (likert)	0.228	0.010	0.406
Credit access (dummy)	-1.950**	-0.088	0.784
Level of bargaining (likert)	0.844***	0.038	0.284
Institutional factors			
Contract implementation (continuous)	-0.0263	-0.001	0.017
Neighbourhood effect	-0.540*	-0.024	0.322

(continuous)			
Extension contacts in 2019 (continuous)	0.291***	0.013	0.093
Network externalities (likert)	1.402***	0.063	0.534
Trust (likert)	-0.831**	-0.037	0.329
Constant	0.238		2.288
Number of observations			207
Log pseudolikelihood			-31.201
Wald Chi2 (17)			74.63
Prob>Chi2			0.000

*, ** and *** denote 10%, 5% and 1% statistical significance levels.

Sorghum farming experience in the study was assumed to have a negative relationship on the proportion of sorghum that was sold to alternative markets which were spot. Experienced farmers would benefit from the targeted VC strategic options on resources and market and also lower producer's transaction costs on search for markets. From Table 16, the results indicate that sorghum farming experience of the household head had a positive and significant influence on the proportion of sorghum side-sold by the sorghum farm enterprises owners. The variable was a contrast to our postulation and was significant at 1%. It also had a positive marginal effect of 0.011 significant at 1% indicating that an increase in farming experience increases the proportion of side selling by 1.1%. It depicts that more experienced sorghum farm enterprise owners' side sold their produce to alternative markets (spot) than less experienced. This is attributed to the fact that, experienced sorghum farmers had more and vast knowledge about the markets than the less experienced sorghum farmers. Producers were also, familiar with the local buyers who acted as alternative markets for their produce. This result is in contrast with that of Shumeta *et al.* (2017) who found out that the fully committed producers had more years of farming experience in coffee production than those who side sold.

The coefficient and marginal effect of off-farm income had a negative influence on the proportion of sorghum side-sold and were significant at 1% significance level. The marginal effect of -0.09 indicates that producers with other forms of incomes were found to be loyal to their targeted VC strategic options compared to those who had no other off-farm income at 9%. This could be because the producers had other sources of income and had no need of cash income. These results are consistent with our assumptions and that of Shumeta *et al*. (2017) who found out that those producers with off-farm income reduced side selling by

4% than those without off-farm income. Additionally, Wollini and Fischer (2015) found a negative relationship with off farm income since the additional source of income is linked to a 2.9% increase in the amount of coffee delivered to cooperatives. However, Repar *et al.* (2018) found out that medium and higher earning producers were likely to side sell than low-income earners as the agreement with the contractor is the only scarce and regular source of income for the low income earners. Anteneh *et al.* (2011) also reported a positive relationship between off-farm income and side selling. He argued that producers with higher incomes delivered coffee to multiple channels unlike those with low income.

Land owned and rented was used as a proxy for the total land size of the household head in acres. The variable was hypothesized to have a negative influence on side selling. From the results in Table 16, the variable was found to have a negative significant relationship with proportion of produce side-sold at 10%. Its marginal effect was at -0.005 and significant at 10%. This indicates that increase in farm size decreases the proportion of side selling by 5%. The reason would be because the farmers tend to incline to sell to their targeted VC strategic options because they have specialized in production of sorghum. Buyers also opt to purchase higher volumes of sorghum from larger sorghum farm enterprise owners reducing their transaction costs lowering the extent of side selling of small-scale producers. These results are consistent with Adjei *et al.* (2017) who reported that a unit increase in the total farm size reduces the possibility of side selling of the sorghum enterprises by 0.56 times. A study by Wollini and Fischer (2015) also found out that the volume of coffee delivered to cooperatives will decrease at a decreasing rate to a point of 18.3ha when it will start increasing with farm size.

A better price offered by alternative markets was among the key variables influencing side selling behaviour of the sorghum farm enterprise owners in the study area. The variable had a positive coefficient and marginal effect of 1% significance level. The marginal effect was at 0.355 indicating that an increase in price at alternative markets will increase a proportion of sorghum side sold to 35.5%. The result was consistent with the expected sign showing that producers will tend to sell their produce to buyers who will offer them the highest prices as they wish to get the highest premium from the products they produced. The highest price would enable them to secure better living for their families. A study by Repar *et al*. (2018) found similar results indicating that most of the farmers who side sold their paprika to alternative markets were due to higher prices offered in those markets. Also, the small-scale farm enterprise owners were not satisfied with the attributes offered in the targeted markets. A similar finding was found by Goel (2013) and Mujawamariya *et al.* (2013) who

stated that small-scale rice producers will opt to choose a company offering better prices over a contractor.

In the study, accessing credit in form of inputs had a negative but significant association with the proportion of sorghum side sold at 5% for both the coefficient and marginal effect. It had a marginal effect of -0.088 and the result was a contrast to our expectations indicating that the more the amount of credit the sorghum enterprise owners obtained from their targeted VC strategic options, the lesser they side sold their produce by 8%. This motivates the farm enterprise owners to supply their produce to their targeted VC strategic options. It could be because the inputs offered by the targeted VC strategic options in form of inputs resulted to more production and income luring producers to remain loyal to their coordinated options. A similar finding was found by Repar *et al*. (2018) who argued the same. However, the result is a contrast to other studies by Shumeta *et al*. (2017) and Wollini and Fischer (2015) who reported that, producers with unsettled credit tend to side sell their produce to alternative markets so as to avoid deductions for the debts.

Involvement of small-scale sorghum producers in formulation of sorghum prices increases the amount of sorghum delivered to the targeted vertical coordination strategic options. This is because the producers will comply with the contract designs reducing the extent of side selling. The level of bargaining power of the sorghum producers on prices and quality in their respective VC strategic options had a positive influence on side selling at a marginal rate of 0.038. This implies that the lower the bargaining powers of the producers, increases the proportions of sorghum side sold by 3.8%. This is in line with the study's expectations and was significant at 1% for both the coefficient and marginal effect. The finding is consistent with Repar *et al.* (2018) who found out that, farmer's active involvement in price formulation lowers the extent of side selling of the farmers.

Neighbourhood effect had a negative coefficient and marginal effect on the proportion of sorghum side sold and was significant at 10%. The marginal effect stood at -0.024. The study had conceptualized farmers living together as relatives and friends within a radius of one kilometre might have a positive influence on the vice. If one of the producers opt to sell their produce to alternative markets, might influence the neighbours to side sell some of their produce at 2.4%. Study by Adjei *et al.* (2017) found a negative effect on side selling and reported that producers are worried about their reputations when they live closer to each other in the community and may not wish to be ashamed before their neighbours. Correspondingly, they may be reported to the local authorities like chiefs who might dispense fairness and penalize sorghum producers who side sold.

Frequency in training per year by the extension officers on both production and marketing activities was thought to reduce the extent of side selling of sorghum producers in the study area. It could have acted as a check on sorghum producers and create good relationship committing producers to the targeted VC strategic options. Results in Table 16 found a positive coefficient with a marginal effect of 0.013 which were significant at 1%. It indicates that sorghum producers who had more contacts with technical officer side sold some of their produce to alternative markets by 1.3%. This effect might be because the producers got more information on the markets and chose to economize fully on the opportunities present in the spot market. This could be the higher prices the VC strategic option was offering to the sorghum producers or the immediate payments offered to satisfy their instant needs, increasing the extent of side selling. Alternatively, the officers did not create good relationship with the farmers reducing their commitment to the prior agreement with the buyer. Studies by Cechin *et al.* (2013), Chaka *et al*. (2016), Donde *et al*. (2016) and Shumeta *et al*. (2017) reported a negative relationship between frequency of extension contacts and side selling.

Network externalities of the producers are perceived to increase the extent of side selling of the sorghum producers. This is because the relational networks are thought to increase the proportion side sold if at all some of the producers practiced side selling. The variable was significant and positively influencing side selling at 1% and the marginal effect was at 0.063. The probability of influencing others was at 6.3%. Repar et al. (2018) also found out similar findings on the effect of network externalities on side selling. He stated that, local community networks have a positive influence on side selling. However, Adjei *et al.* (2017) found a negative influence on side selling and argued that, social networks brings the sense of belonging discouraging the acts of cheating.

The trust producers had towards their targeted buyers was theorized to reduce the proportion of side selling in the sorghum value chain. This could be because, trust increases transparency and accountability of the buyers and the producers could perceive that the targeted VC strategic options could be acting in their interests. From the results in Table 16, it was found to have a negative effect on the extent side selling and had a significance of 5%. Also, the marginal effect was at -0.037 and was significant at 5%. This indicates that the more the trust producers have on their targeted VC strategic options the lesser they are likely to side sell by 3.7% reducing side selling. Wollini and Fischer (2015) reported that trust increases the amount of produce delivered to cooperatives by 5%. Bakucs *et al*. (2013) also argued that, trust reduces formal written contracts and side selling action. Also other studies

(Bijman & Verhees, 2011; Jussila *et al*., 2012; Shumeta *et al*., 2017) are in line with the above findings that cognitive trust of the producers reduces the likelihood of side selling.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1: Conclusions

From analysis three key observations were made from the results.

i. Results indicate that majority of the sorghum producers in the Kisumu County targeted two vertical coordination (VC) strategic options during production and these were contractors and processors. This indicates that farm enterprise owners in the study area chose to coordinate their production and marketing activities with the buyer in order to gain access to industrial markets. The targeted VC strategic options had varied market attributes which attracted the sorghum producers differently and the VC strategic options were not mutually exclusive.

ii. The results also affirm that institutional arrangements or attributes of each vertical coordination option have an influence on the choice of VC strategic options. The results reveal that the choice of spot market was influenced by young age, more sorghum experience, less farm sizes, fair price expectation, less payment delay, more bargaining power, transportation disarrangement, distance to collection point and grade uncertainty. Then choice of contractors was influenced by less farm sizes, quality inspection, payment delay, more bargaining power, transportation arrangement, distance to collection point and less technical support. For sorghum producers choosing processors, off farm income, more land size, less payment delays, less bargaining power and transportation disarrangement influenced their choice positively.

iii. Further results show that 73% of the producers sold part of their produce to alternative markets which were spot markets despite them targeting VC strategic options. This was because of higher prices offered in the former than the coordinated prices. Moreover, higher bargaining power, sorghum experiences, contacts with extension officers and network externalities induced side selling effect of the producers. However, off farm income, land size, access to credit, neighbourhood effect and trust reduced side selling remarkably.

5.2 Recommendations

i. Since institutional arrangements played a pivotal role in influencing the choice of different vertical coordination strategic options, this study recommends that producers should be given prices close to producers expectations by incorporating them in setting the fixed prices by increasing their bargaining powers. Also, price premiums should be offered to them due to delays and on product quality as they are thought to encourage sorghum

producers to utilize contractor's options. Equally, good roads will encourage producers to participate in higher vertical coordination strategic options. Similarly, the produce should be transported immediately after aggregation in order to prevent deterioration of the produce's quality lowering grade uncertainty among the producers.

ii. To reduce the side selling behaviours of the farm enterprise owners, emphasis should be placed on trust between the buyers, bargaining power and monitoring of farm enterprises. Trust encourages long-term relationships with the partners reducing side selling effect. This trust can be achieved through ensuring information flow between the buyers increasing market information of the producers and also incorporating them in decision making. For bargaining power, farm enterprise owners should be integrated in setting the prices and quality which might sensitize small-scale producers to comply with the contract terms reducing the leaking of sorghum to alternative markets.

Additionally, sorghum producers should be encouraged to participate in groups and cooperatives in order to increase their bargaining power. Monitoring through neighbours discourages side-selling since producers are worried about their reputations and feel may be reported to local authorities to dispense fairness. In addition, Agribusiness firms and processors should offer better prices and prompt pays to prevent side selling behaviour among the farm enterprise owners. Similarly, they can offer product advances after delivery which will meet producer's immediate needs lowering side selling behaviour.

5.3: Areas for further research

This research focused mainly on the producer's choice of different emerging markets using econometric models using the case of sorghum farm enterprise owners in Kisumu County. Normally, econometric models depend entirely on the data, the sample or the decision being analysed making it less or more accurate. Further research can be done using discrete choice experiments to determine the preferences of producers towards these sorghum market options based on their institutional arrangements. Other studies could also focus on measuring the transactional costs in the institutional arrangements such as transportation cost, and technical services other than using the transactional features as we have done in the current study. Likewise, side selling effect has become problematic and more studies on the determinants of side selling in the different supply chains should be done as the results obtained might not be applicable to all supply chains.

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APPENDICES

Appendix A: Household Questionnaire

Questionnaire Number……

Name of Enumerator……..

My name is Janet Sigara, a student at Egerton University conducting a survey on **Vertical Coordination Strategic Options on sorghum supply chain in Nyando Sub-county, Kisumu County**. The information will help in formulating policies and programs that will provide important basis for relevant interventions in the area. You have been selected to participate in this research however your participation is voluntary. Any information provided by you will be treated strictly confidential and your name will not appear at any level of report writing.

Respondent identification

Name of Farmer…….

Phone number……..

Section One: Demographic information (tick where appropriate)

1.1 Gender of the household head (key decision maker): (1) Male (2) Female

1.2 Main Occupation of the household head? (1) Farmer (2) Business (3) Formal employment (4) Casual workers

1.3 Age of the household head……..years.

1.4 Household size…….. (Household member who have stayed for at least 4months in the last 12 months)

First name	Household age	Gender

1.5 Years of schooling completed by the household head ……

1.6 Apart from farming, do you have any other form of income? (1) Yes (0) No

Section Two: Sorghum production

2.1 How many years have you been in sorghum production……years

2.2 What is the total land size owned or leased for agricultural activities?

Owned in acres …….

Rented in acres ……..

2.3 What is the land under sorghum production in April 2019?..... acres

2.4 How many Kgs of sorghum did you produce in April, 2019?.....

Section Three: Marketing of Sorghum

3.1 Whom did you sell your sorghum to? (1) contractor (2)cooperative (3) group adding value (4) processor

3.2 How many kgs of sorghum did you sell from the 2019 production?.....

3.3 Whom were you targeting when you were making decision of producing sorghum in april last year? (1) contractor (2)cooperative (3) group adding value (4) processor (5) middlemen (6) spot (7) institutions

3.4 The quantity sold to the targeted buyer?……Kgs

3.5 At what price did you sell your sorghum to target buyers? ……..

3.6 Was the price offered close to your expectations? 1) Yes 0) No

3.7 Were you certain of the price you were to be offered by your target buyer? 1) Yes 0) no

3.8 How easy is it to get an alternative market for sorghum apart from your target market?

(1) Difficult (2) Fair (3) Easy

3.9 Is your sorghum graded before being sold to any of the targeted buyer? (1) Yes (0) No

3.10 Were you certain of the grade after delivering to your target buyer or you were charged further? 0) No 1) Yes

3.11 How far is the collection point of the target buyer from your home?

3.12 Do you have contractual agreement with any of the targeted buyer? (1) Yes (0) No

3.13 In April 2019, what was the contract agreement with your target buyer? 0) no form of prior agreement 1) prior oral agreement 2) prior written contracts

3.14 In April 2019, what was your contract specification in terms of price? 0) no pre-agreed price 1) pre-agreed price

3.15 In April 2019, did you receive fertilizer from your target buyer? 0) No 1) Yes

3.16 In April 2019, did you access sorghum seeds from your target buyer? 0) No 1) Yes

3.17 In April 2019, did you acquire credit from your target buyer? 0) No 1) Yes

3.18 How much did you borrow?.....Kshs

3.19 To what extent (in a scale of 0-100%) does your target buyer implement the contract?.....

3.20 What is the distance to your target market in kilometres? …….

3.21 What is the distance to your target market in minutes ? ……..

3.22 What is the number of farmers growing sorghum in a radius of half a kilometre?.....

3.23 Type of road used to the market (1) Tarmac (2) Rough road (3) Both

3.24 Who arranges for sorghum transportation? (1) Farm enterprise owners(2) Buyer 3) Both

3.25 Do you own a transport equipment? 0) None 1)truck 2) pick up 3) car 4) motorbike 5) bicycle 6) animal cart 7) wheelbarrow

3.26 How long does it take to receive your payments? ……..days.

3.27How many days did the payment delay as per your agreement with the buyer?.....days

Section four: Marketing information and social influence

4.1 The ease of getting market information in relation to market and technology?1) very difficult 2) difficult 3) medium 4) easy 5) very easy

4.2 Please rank the following questions in relation to decision making on sorghum production and marketing

Likert items on networking externalities	SD	D	N	A	SA
Those whom I associate most with think we should participate in commercialization of sorghum					
Family members think I should participate in commercialization of sorghum					
My relatives think I should participate in commercialization of sorghum					
My friends think I should participate in commercialization of sorghum					
Important people to me think I should participate in commercialization of sorghum					
People influencing my behaviour think I should participate in commercialization of sorghum					
My fellow workers think I should participate in commercialization of sorghum					
My peers at my workplace think I should					

participate in commercialization of sorghum					

4.3 Are you a member of a group? (1) Yes (0) No

Section Five: Extension services

5.1 Did you receive any extension services in the 2019 sorghum production period? (1) Yes (0) No

5.2 How many contacts did u have with the extension officers in the year 2019……..

5.3 The distance to the nearest extension service provider in kilometres?.....

5.4 Rank your farmers' skills in sorghum production. 1) very poor 2) poor 3) moderate 4) high 5) very high

5.5 Does your target buyer supports you with extension services? 1) strongly disagree 2) disagree 3) neutral 4) agree 5) strongly agree

Section Six: Pricing

6.1 The level of bargaining with your target buyer? 1) passively accepting 2) little bargaining power 3) moderate bargaining power 4)nearly equal bargaining power 5)equally negotiating the price

6.2 The extent does the following influence you.

Likert items on behavioral uncertainty	SD	D	N	A	SA
I have no clue about the prices I will be offered by my target buyer beforehand					
I do not know the quality requirements of my target buyer before hand					
I incurred loss due to decisions that were made without consulting me					
I experienced loss as a result of delayed payments by my target buyer					

6.3 To what extent has weather affected your production negatively in the past 5 years? 1) very little 2) little 3) moderate 4) much 5) very much

6.4 Do you trust your buyers (1) Yes (0) No

6.5 The extent of trust

Likert items on trust	SD	D	N	A	SA
My target buyer keeps frequent contacts and interaction with me					

My instincts tells me that my target buyer can be truthful and trusted					
I do obey the rules set with my target buyer					

Appendix B: Multivariate Probit Results

Multivariate probit (SML, # draws = 5) Number of obs = 274

Wald chi2(51) = 188.12

Log likelihood = -256.62023 Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
contractor						
genderofhhh	-.2138783	.2016758	-1.06	0.289	-.6091557	.181399
ageofhhh	-.006001	.0084343	-0.71	0.477	-.022532	.01053
household_size	-.1106133	.0611875	-1.81	0.071	-.2305387	.0093121
yearsofschoo~h	.0163823	.0298118	0.55	0.583	-.0420477	.0748124
otherformofi~e	-.0510968	.2111456	-0.24	0.809	-.4649344	.3627409
yearsinsorgh~n	-.0154806	.0217513	-0.71	0.477	-.0581124	.0271513
landownedand~d	.0070724	.0255359	0.28	0.782	-.0429769	.0571218
farmspeciali~n	-.0530877	.3996083	-0.13	0.894	-.8363055	.7301301
closetoexpec~s	.0055342	.2864512	0.02	0.985	-.5558997	.5669682
certai0fgrade	-.3959235	.3023868	-1.31	0.190	-.9885909	.1967438
credit	-.339475	.2811266	-1.21	0.227	-.890473	.2115231
arrangesfort~n	1.585915	.2490502	6.37	0.000	1.097785	2.074044
levelofbarga~g	.1854964	.1020194	1.82	0.069	-.014458	.3854509
buyersupport~t	-.1725689	.0865358	-1.99	0.046	-.3421759	-.0029619
kmstocollect~t	.0404873	.0218019	1.86	0.063	-.0022438	.0832183
paymentagree~t	.0509641	.0301661	1.69	0.091	-.0081604	.1100886
issorghumgra~d	1.083494	.4721543	2.29	0.022	.1580885	2.008899
_cons	-2.186729	1.043691	-2.10	0.036	-4.232326	-.1411317
processor						
genderofhhh	.2924552	.285895	1.02	0.306	-.2678888	.8527991
ageofhhh	.0140571	.0105179	1.34	0.181	-.0065576	.0346719
household_size	-.0922618	.0826288	-1.12	0.264	-.2542113	.0696876
yearsofschoo~h	-.0009973	.0404577	-0.02	0.980	-.080293	.0782983
otherformofi~e	.6169948	.3088966	2.00	0.046	.0115685	1.222421

```
yearsinsorgh~n |  -.0282346   .0276715    -1.02   0.308    -.0824697    .0260006
landownedand~d |   .0669406   .0324314     2.06   0.039     .0033762     .130505
farmspeciali~n |   .2996205   .5473162     0.55   0.584    -.7730996    1.372341
closetoexpec~s |  -.4575772   .3979993    -1.15   0.250    -1.237641    .3224871
 certai0fgrade |   .2511379    .469065     0.54   0.592    -.6682127    1.170489
       credit |  -.1505585   .4814203    -0.31   0.754    -1.094125     .793008
arrangesfort~n |  -2.528109   .3783858    -6.68   0.000    -3.269732   -1.786487
levelofbarga~g |  -.3258061   .1373923    -2.37   0.018     -.59509   -.0565222
buyersupport~t |   .1149925   .1149695     1.00   0.317    -.1103436    .3403287
kmstocollect~t |  -.0096278   .0251801    -0.38   0.702    -.0589799    .0397243
paymentagree~t |  -.1164677   .0473943    -2.46   0.014     -.209359   -.0235765
issorghumgra~d |  -.6866149   .6196848    -1.11   0.268    -1.901175    .5279449
       _cons |   3.742752   1.405781     2.66   0.008     .9874722    6.498032
--------------+----------------------------------------------------------------
spot          |
  genderofhhh |  -.1903444   .2055404    -0.93   0.354    -.5931961    .2125073
     ageofhhh |  -.0241441   .0091822    -2.63   0.009    -.0421409   -.0061472
household_size |   .0546439   .0694072     0.79   0.431    -.0813917    .1906795
yearsofschoo~h |   .0496466   .0325174     1.53   0.127    -.0140864    .1133796
otherformofi~e |  -.3346473   .2229549    -1.50   0.133    -.7716309    .1023362
yearsinsorgh~n |   .0768818   .0229907     3.34   0.001     .031821    .1219427
landownedand~d |  -.1102189   .0353539    -3.12   0.002    -.1795112   -.0409266
farmspeciali~n |  -.5153919   .4239427    -1.22   0.224    -1.346304    .3155205
closetoexpec~s |   .9886978   .3647597     2.71   0.007     .273782    1.703614
 certai0fgrade |   .8632009   .3155337     2.74   0.006     .2447663    1.481636
       credit |  -.3603762   .2553974    -1.41   0.158     -.860946    .1401935
arrangesfort~n |  -.6077686   .2678528    -2.27   0.023    -1.13275   -.0827868
levelofbarga~g |   .2654091   .1191087     2.23   0.026     .0319605    .4988578
buyersupport~t |  -.0404855   .0849882    -0.48   0.634    -.2070593    .1260884
kmstocollect~t |   .0701581   .0193543     3.62   0.000     .0322244    .1080918
paymentagree~t |  -.1265728   .0325941    -3.88   0.000    -.1904562   -.0626895
issorghumgra~d |  -.5356889   .5173638    -1.04   0.300    -1.549703    .4783257
       _cons |   1.653604    1.00847     1.64   0.101    -.3229617    3.630169
--------------+----------------------------------------------------------------
```

```
   /atrho21 |   .0617797    .187278     0.33   0.741    -.3052785    .4288379
------------+----------------------------------------------------------------
   /atrho31 |  -.2504542   .1792829    -1.40   0.162    -.6018422    .1009338
------------+----------------------------------------------------------------
   /atrho32 |  -1.237294   .5336302    -2.32   0.020     -2.28319   -.1913975
------------+----------------------------------------------------------------
      rho21 |   .0617012   .1865651     0.33   0.741    -.2961357    .4043496
------------+----------------------------------------------------------------
      rho31 |  -.2453456    .168491    -1.46   0.145    -.5383591    .1005924
------------+----------------------------------------------------------------
      rho32 |  -.8446819   .1528917    -5.52   0.000    -.9794228   -.1890941
------------------------------------------------------------------------------
Likelihood ratio test of  rho21 = rho31 = rho32 = 0:
          chi2(3) =  22.7442    Prob > chi2 = 0.0000
```

The marginal Effects used in the model are shown below. Contractor's independent variables were generated first, followed by processor then finally spot market.

```
ME_gende~tor |       274   -.0499458    .0230364  -.0852284  -.0009332
-------------+----------------------------------------------------------
ME_ageof~tor |       274   -.0014014    .0006464  -.0023913  -.0000262
ME_house~tor |       274   -.0258309    .0119139  -.0440783  -.0004826
ME_Educa~tor |       274   -.0123973     .005718  -.0211549  -.0002316
ME_Offfa~tor |       274   -.0119324    .0055035  -.0203616  -.0002229
ME_Sorex~tor |       274   -.0065935    .0030411  -.0112512  -.0001232
-------------+----------------------------------------------------------
ME_Farms~tor |       274    .0016516    .0007618   .0000309   .0028183
ME_farms~tor |       274   -.0123973     .005718  -.0211549  -.0002316
ME_Expec~tor |       274    .0012924    .0005961   .0000241   .0022053
ME_certa~tor |       274    .0586469    .0270495   .0010957   .1000759
ME_credi~tor |       274   -.0792757    .0365641  -.1352774  -.0014812
-------------+----------------------------------------------------------
ME_Trans~tor |       274     .37035    .1708155   .0069196   .6319712
ME_barga~tor |       274     .043318    .0199794   .0008093   .0739185
ME_buyer~tor |       274     .043318    .0199794   .0008093   .0739185
```

```
ME_colle~tor |       274    .0094548    .0043608   .0001767   .0161338
ME_payme~tor |       274    .0119014    .0054892   .0002224   .0203087
-------------+------------------------------------------------------------
ME_issor~tor |       274    .2530224    .1167008   .0047274   .4317615
ME_gende~sor |       274    .0682955    .0314997    .001276   .1165405
ME_ageof~sor |       274    .0032827    .0015141   .0000613   .0056016
ME_house~sor |       274   -.0215454    .0099373  -.0367654  -.0004026
ME_Educa~sor |       274   -.0002329    .0001074  -.0003974  -4.35e-06
-------------+------------------------------------------------------------
ME_Offfa~sor |       274   -.0119324    .0055035  -.0203616  -.0002229
ME_Sorex~sor |       274   -.0065935    .0030411  -.0112512  -.0001232
ME_Farms~sor |       274    .0156323     .00721   .0002921   .0266752
ME_farms~sor |       274    .0699687    .0322715   .0013073   .1193958
ME_Expec~sor |       274   -.1068555    .0492847  -.1823399  -.0019965
-------------+------------------------------------------------------------
ME_certa~sor |       274    .0586469    .0270495   .0010957   .1000759
ME_credi~sor |       274   -.0351591    .0162163  -.0599961  -.0006569
ME_Trans~sor |       274   -.5903754    .2722972  -1.007426  -.0110305
ME_barga~sor |       274   -.0760837    .0350919  -.1298305  -.0014215
ME_buyer~sor |       274    .0268536    .0123856   .0005017   .0458234
-------------+------------------------------------------------------------
ME_colle~sor |       274    .0268536    .0123856   .0005017   .0458234
ME_payme~sor |       274   -.0271981    .0125445  -.0464112  -.0005082
ME_issor~sor |       274   -.1603414    .0739538  -.2736092  -.0029958
ME_gendero~t |       274   -.0444501    .0205016  -.0758503  -.0008305
ME_ageofhh~t |       274   -.0056382    .0026005  -.0096212  -.0001053
-------------+------------------------------------------------------------
ME_househo~t |       274    .0127607    .0058856   .0002384    .021775
ME_Educati~t |       274    .0115937    .0053473   .0002166   .0197837
ME_Offfarm~t |       274   -.0781483    .0360441  -.1333536  -.0014601
ME_Sorexp_~t |       274    .0179538    .0082808   .0003354   .0306366
ME_Farmsz_~t |       274   -.0257388    .0118714  -.0439211  -.0004809
-------------+------------------------------------------------------------
ME_farmspe~t |       274   -.1203566    .0555118  -.2053785  -.0022487
```

```
ME_Expecta~t |       274    .2308852    .1064905   .0043138   .3939862
ME_certai0~t |       274    .2015786    .0929735   .0037663   .3439769
ME_credit_~t |       274   -.0841567    .0388154  -.1436063  -.0015724
ME_Transar~t |       274   -.1419289    .0654615  -.2421897  -.0026518
-------------+------------------------------------------------------------
ME_bargain~t |       274    .0619795    .0285866    .001158   .1057629
ME_buyerex~t |       274    .0619795    .0285866    .001158   .1057629
ME_collect~t |       274    .0163836    .0075566   .0003061   .0279573
ME_payment~t |       274   -.0295579    .0136329   -.050438  -.0005523
ME_issorgh~t |       274   -.0295579    .0136329   -.050438  -.0005523

.
```

Appendix C: Fractional Response Model Results

Fractional logistic regression Number of obs = 207

Wald chi2(17) = 74.63

Prob > chi2 = 0.0000

Log pseudolikelihood = -31.201087 Pseudo R2 = 0.7089

| Robust

proportion | Coef. Std. Err. z P>|z| [95% Conf. Interval]

genderofhhh | -.2969917 .6009449 -0.49 0.621 -1.474822 .8808387

ageofhhh | -.0484763 .033338 -1.45 0.146 -.1138175 .0168649

yearsofschoolingcompletedbyhhh | -.0123427 .1185565 -0.10 0.917 -.2447091 .2200238

yearsinsorghumproduction | .242307 .0769868 3.15 0.002 .0914157 .3931984

otherformofincome | -1.987599 .7292521 -2.73 0.006 -3.416907 -.5582913

landownedandrented | -.1006841 .0565457 -1.78 0.075 -.2115117 .0101434

betterprices | 7.900279 1.911622 4.13 0.000 4.153568 11.64699

easetogetalternativemarket | .2278525 .4060455 0.56 0.575 -.5679822 1.023687

kmstocollectionpoint | .0450233 .0390526 1.15 0.249 -.0315184 .121565

credit | -1.949746 .7841006 -2.49 0.013 -3.486555 -.4129375

contractimplementation | -.0262953 .0167935 -1.57 0.117 -.0592099 .0066193

a_1sinaradiusofakm | -.5396453 .3222842 -1.67 0.094 -1.171311 .0920201

timeonereceivedpayment | -.1872051 .1166416 -1.60 0.109 -.4158185 .0414083

contactsin2019 | .290914 .0925255 3.14 0.002 .1095673 .4722607

levelofbargaining | .8441134 .2838503 2.97 0.003 .287777 1.40045

networkexternalities | 1.401873 .534127 2.62 0.009 .3550039 2.448743

trust | -.8306623 .3287384 -2.53 0.012 -1.474978 -.186347

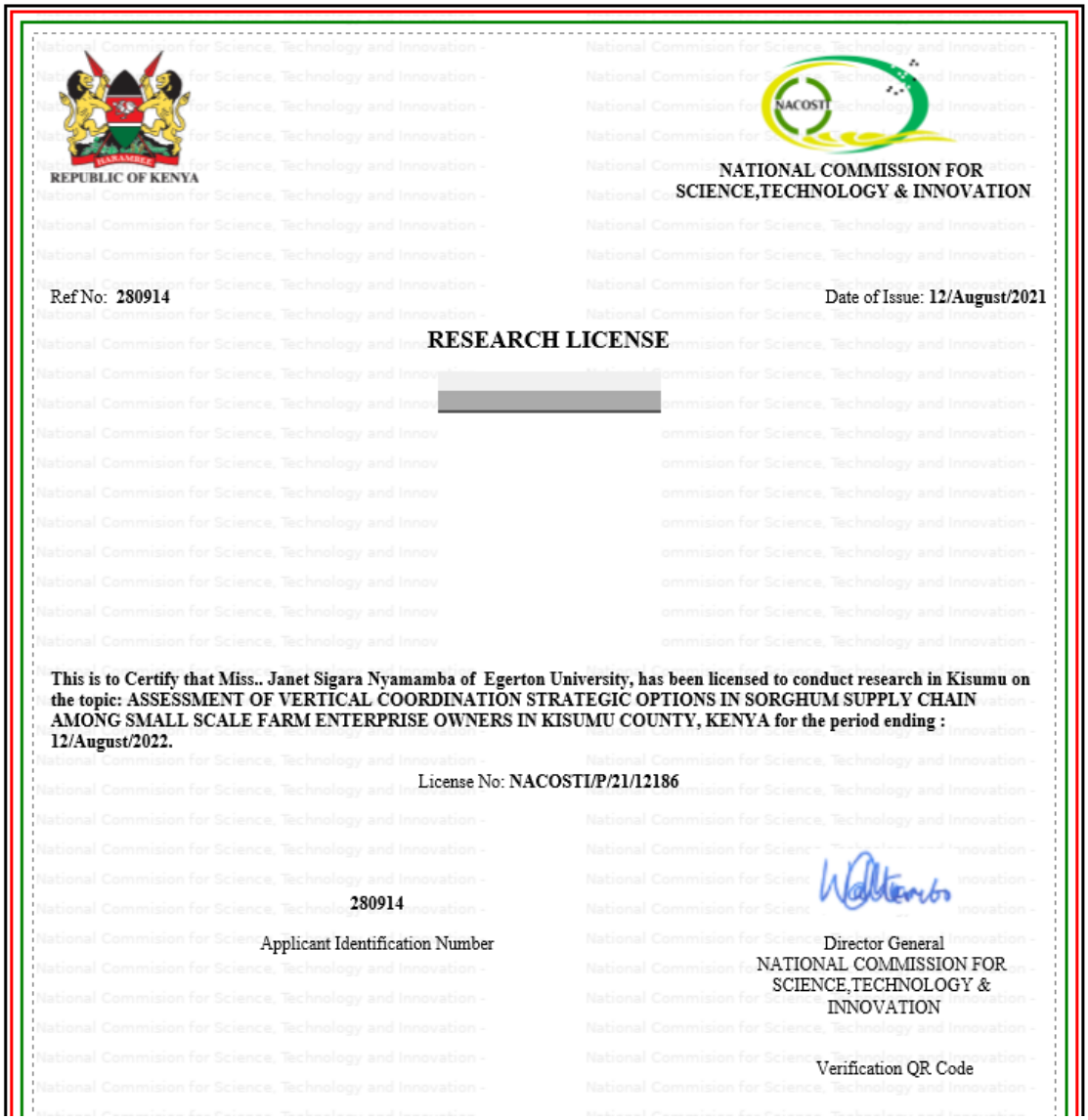
_cons | .2377311 2.287602 0.10 0.917 -4.245886 4.721348

. margins, dydx (*)

Average marginal effects Number of obs = 207

Delta-method				
dy/dx	Std. Err.	z	P>|z|	[95% Conf. Interval]
genderofhhh	-.0133474	.0277154	-0.48	0.630	-.0676685	.0409736
ageofhhh	-.0021786	.0013302	-1.64	0.101	-.0047858	.0004286
yearsofschoolingcompletedbyhhh	-.0005547	.0052865	-0.10	0.916	-.0109161	.0098067
yearsinsorghumproduction	.0108898	.0024944	4.37	0.000	.0060008	.0157788
otherformofincome	-.089327	.034611	-2.58	0.010	-.1571632	-.0214908
landownedandrented	-.004525	.0024087	-1.88	0.060	-.0092459	.000196
betterprices	.3550555	.0424912	8.36	0.000	.2717743	.4383366
easetogetalternativemarket	.0102402	.0174443	0.59	0.557	-.02395	.0444303
kmstocollectionpoint	.0020234	.0017038	1.19	0.235	-.001316	.0053629
credit	-.0876258	.0388082	-2.26	0.024	-.1636884	-.0115632
contractimplementation	-.0011818	.0008273	-1.43	0.153	-.0028033	.0004398
a_1sinaradiusofakm	-.0242528	.012181	-1.99	0.046	-.0481271	-.0003786
timeonereceivedpayment	-.0084134	.004222	-1.99	0.046	-.0166884	-.0001384
contactsin2019	.0130743	.0044717	2.92	0.003	.0043099	.0218387
levelofbargaining	.0379363	.010094	3.76	0.000	.0181524	.0577202
networkexternalities	.0630032	.018182	3.47	0.001	.0273671	.0986393
trust	-.0373317	.0133929	-2.79	0.005	-.0635813	-.0110822

Appendix D: Research Permit (NACOSTI)



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Date of Issue: **12/August/2021**

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This is to Certify that Miss.. Janet Sigara Nyamamba of Egerton University, has been licensed to conduct research in Kisumu on the topic: ASSESSMENT OF VERTICAL COORDINATION STRATEGIC OPTIONS IN SORGHUM SUPPLY CHAIN AMONG SMALL SCALE FARM ENTERPRISE OWNERS IN KISUMU COUNTY, KENYA for the period ending : 12/August/2022.

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Appendix E: Publications

Nyamamba et al., Cogent Economics & Finance (2022), 10: 1986932
https://doi.org/10.1080/23322039.2021.1986932

cogent economics & finance

GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Determinants of side selling behaviour in emerging sorghum supply chains in Kisumu County, Kenya

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Goodness Aye, Agricultural Economics, University of Agriculture, Makurdi Benue State, Nigeria

Additional information is available at the end of the article

Abstract: Vertical coordination in agriculture has received popularity in recent years. They have emerged to transform farm enterprises from subsistence farming to commercially oriented production. Despite the importance attached to them, some farm enterprise owners are involved in side selling even though they are committed to specific vertical coordination strategic options. Factors influencing this behaviour are still unclear in the empirical literature. This study intends to bridge this gap by determining the extent of side selling in sorghum supply chains in Kisumu County. A stratified sampling technique was used to collect data from 266 sorghum farm enterprises. Primary data was obtained through interviews using a pre-tested semi-structured questionnaire administered by trained enumerators. The study used Fractional Response Model to determine the extent of side selling among sorghum farm enterprises. Results from Fractional Response Model reveal that farming experience, better prices from alternative markets, neighbourhood effect, frequency of contacts, low bargaining power and network externalities influence side selling positively. Whereas other forms of income, land size, credit access and trust reduces the probability of side selling. These results indicate that policymakers should generate policies that will strengthen the legal institutions in agriculture regarding breaching of agreements reducing the side selling behaviours of sorghum producers.

Subjects: Agriculture & Environmental Sciences; Sociology & Social Policy; Business, Management and Accounting

Janet Sigara Nyamamba

ABOUT THE AUTHOR

Janet Sigara Nyamamba (Msc) is a student at Egerton University in the department of Agricultural Economics and Agribusiness Management. She is a director at Jasiga Limited Company and is currently engaged in community work. My research interests include value chain, agricultural marketing and strategic management.

PUBLIC INTEREST STATEMENT

Agribusiness systems are changing rapidly towards modern value chains in order to respond to changes in dietary needs, rising incomes, urbanization and population growth. Studies have shown that participation of farm enterprise owners in high agricultural value chains improves their welfare. Despite the findings, farm enterprise owners in Kisumu County, Kenya are partially involved in these value chains while some are not. A number of those involved in the value chains are partially selling their sorghum to alternative markets breaking the agreement. Thus, this study draws policies and strategies that can be put in place in order to curb this vice and increase the efficiency of these value chains in Sub-Saharan Africa.

cogent oa

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