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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

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

Janet Sigara Nyamamba<sup>1\*</sup>, Oscar Ingasia Ayuya<sup>2</sup> and Kenneth Waluse Sibiko<sup>2</sup>

**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

Agri-food 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 bridging 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.

**Keywords: side selling; supply chain; vertical coordination strategic options; vertical coordination**

## 1. Introduction

In Sub-Saharan countries, 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 together with food grades and high standards have spurred up the reconstruction of the modern agrifood value chains (Henderson and 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 up more opportunities for producers in developing countries initiating 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 farmers from accessing new technologies, technical services, quality inputs and market opportunities. The absence of these value chains makes it difficult for the farm enterprise owners to act following the stringent quality and safety necessities of the high-end markets (Alemu et al., 2016). To grab these opportunities, they need to coordinate their activities in order to meet the required quality by agribusiness buyers.

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). 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 enterprises (van Wijk and Kwakkenbos, 2011). Most of the farm enterprise owners are involved in the chain and are utilizing different vertical coordination strategic options to market their produce. Despite the choices on these vertical coordination 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).

Side selling seems to be economically unsound but it remains to be a rational decision from a small-scale farmer's livelihood perspective (Mujawamariya et al., 2013). However, side selling has remained to be the main challenge in vertical coordination strategic option's 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 (2014), Mujawamariya et al. (2013), Shumeta et al. (2018), and Repar et al. (2018), but 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 intends to bridge this gap by considering the policy related variables stated above and secondly, it introduces a new innovative model to analyze the extent of side selling and the motivations behind the side selling behaviour of the sorghum producers. Understanding the drivers initiating farm enterprise owners to side sell their coordinated produce to alternative vertical coordination strategic options can help aggregators to get hold of the vice with little use of resources. To obtain the determinants, Fractional Response Model was used over Ordinary Least Squares as it could predict values within the limit of the bounded dependent variable (percentage of the marketable surplus) and capture the non-linearity effect (Gallani et al., 2015).

This paper is well-thought-out as follows. Section 2 presents the literature review, section 3 highlights on research methodology entailing study area, sampling design, description of variables and econometric modelling. Section 4 provides results and discussions, section 5 details on conclusion, recommendations and suggestions for further studies and section 6 entails policy implications.

## 2. Literature review

### 2.1. Side selling behaviour in vertical coordination strategic options

Despite much emphasis on vertical coordination strategic options, concerns on free riding problems are on rise such as side selling across the world (Gerard et al., 2020; Mojo et al., 2017; Mwambi et al., 2016). The stated vice occurs when yields are sold to alternative vertical coordination strategic options other than the targeted ones which did not offer any service to the producers like 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, 2015), 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 also resolve disputes in ex-post (Kunte, 2015).

Murekezi et al. (2012) and Repar et al. (2018) gave a valuable intuition on the drivers of side selling stating that small-scale farm enterprise owners have inadequate prospects of getting an income and over and over again need money to meet their dietary needs of the households. Alternatively, Mujawamariya et al. (2013), E. Fischer and Qaim (2014), Malan et al. (2015), and Shumeta et al. (2018) stated that delays in payment induce small-scale farm enterprise owners to side sell the coordinated produce to traders. Correspondingly, Minot (2011), and Adjei et al. (2017) revealed that once prices in alternative vertical coordination strategic options increase than the coordinated price they had agreed upon, 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 vertical coordination strategic option engaged in does not bid the highest, the small-scale farmers will hunt and sell their produce out of the vertical coordinated strategic option (Shepherd, 2007). Minot (2011) and Adjei et al. (2017) added that sharing of information, group involvement and regular monitoring can normalize defaulting and side selling in higher levels of vertical coordination strategic options.

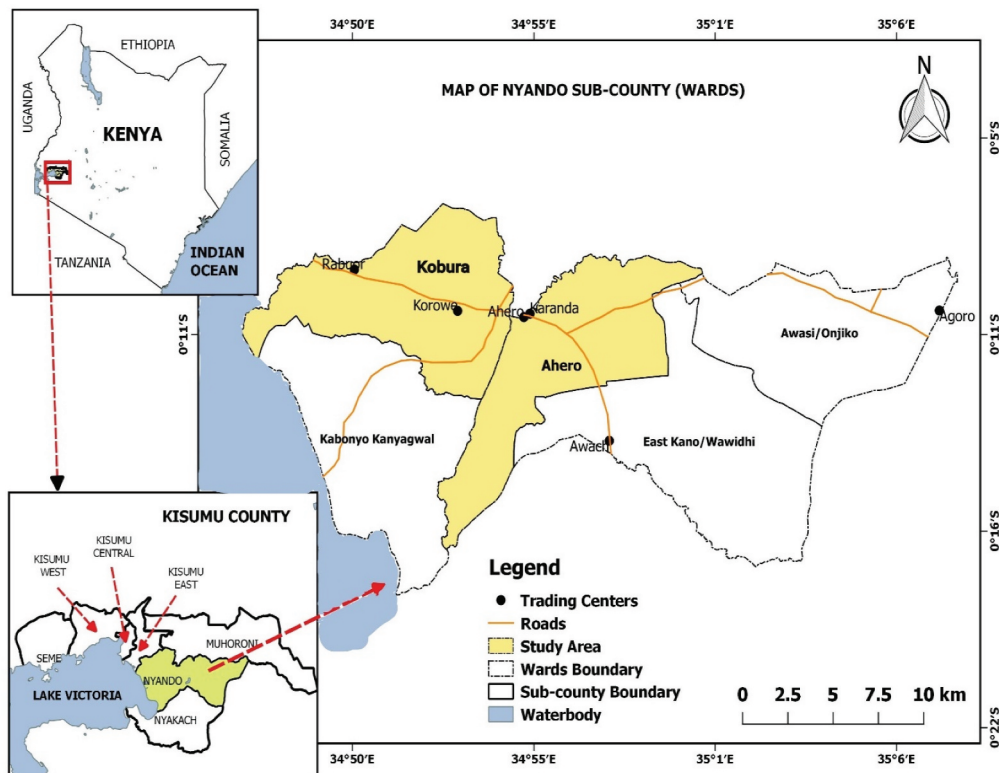
## 3. Research methodology

### 3.1. Description of the 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 enterprises (CIDP, 2018). It is also among the few counties with an established brewing plant which sources sorghum from small-scale farm enterprise owners for malting purposes. The County covers a total land area of 2085.9 square kilometers (GoK, 2014). 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 (15–29 yrs). 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, thus 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, 2014). The mean annual maximum temperature ranges between 25°C and 35°C, while minimum temperatures range between 9°C and 18°C.

**Figure 1. Map of the study area, Nyando Sub-County.**



The study focused in Nyando Sub-County which has five agribusiness firms who have obtained agency number from the malting company (EABL). The agency allows them to consolidate the produce and sell it to the industry reducing the farmers' transaction costs. The contractors are Transu limited, Mosco, Royce, Kisumu heralds and East Africa affordable (Figure 1). Also, some farmers have the agency to distribute directly to the EABL. Lastly, it has micro-processors who add value to the sorghum grains by milling and baking biscuits, bread and cakes.

### 3.2. Sampling procedure, data and sample size

The study used personal interviews with the household head in order to obtain data on sorghum's renowned vice in vertical coordination strategic options that affected both small-scale farm enterprise owners and aggregators or contractors (side selling) in the year 2019. Multi-stage sampling design was used to obtain respondents for the study in Kisumu County. First stage was based on the emphasis on sorghum production in the region and a brewing plant establishment in the County. Second stage was based on the number of farm enterprise owners engaged in the higher levels of vertical coordination strategic options. Since the vertical coordination strategic options were heterogeneous, proportionate sampling was used to obtain the total sample size for each stratum. Finally, simple random sampling was used to select the number of sorghum farm enterprise owners from each of the selected wards. Samples of 266 farm enterprises were selected from the population of small-scale farm enterprise owners in the county.

### 3.3. Data and descriptive statistics

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 vertical coordination 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 and SPSS software was used for data processing and analysis. Both econometric and descriptive analyses were used to analyze the obtained data.

### 3.4. Descriptive statistics

To obtain the characteristics of the institutional arrangements of the different vertical coordination strategic options in the County, descriptive statistics such as mean, percentage, mode and frequency in the form of tables, pie 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, human behaviours and transaction features such as asset specificity, market uncertainty and frequencies.

### 3.5. Description of variables

#### 3.5.1. Dependent variable

The study's dependent variable was considered to be the percentage of the marketed surplus sold to alternative vertical coordination strategic options. The variable was a proportion calculated from the total amount of sorghum marketed from April's 2020 production. Data were collected on the amount of sorghum sold to the targeted vertical coordination strategic options against the amount sold to alternative strategic options. The dependent variable ranged between 0 and 1.

#### 3.5.2. Independent variables

Table 1 and 2 shows the independent variables used to influence farmers' choices on side selling behaviour. The determinants were drawn from previous studies on side selling in cooperatives. We included explanatory variables related to farmer characteristics, farm characteristics, economic motivations and institutional factors which influence farmer decisions in side selling. Farmer characteristics captured were age, gender, education, sorghum farming experience and off-farm employment. Wollni and Fischer (2015) found age and level of education to have a positive and significant effect on side selling while Mujawamariya et al. (2013) found a positive effect of household head age and farming experience commits members to cooperatives. Our study had hypothesized that farmers who are better educated, older and experienced tend to side sell less. Off farm income had a negative relationship as farmers with alternative cash income have a lower discount rate thus committing themselves to the targeted vertical coordination strategic options.

Farm characteristics included farm size of the household in acres and site distance to sorghum collection point in kilometres/minutes. The variables were drawn from Anteneh et al. (2011) study who found out land size had a positive and significant effect on side selling. However, Wollni and Fischer (2015) reported a negative relationship. The distance to sorghum collection point was hypothesized to have a positive influence to side selling as sorghum producers located far from collection point may opt to side sell than those near collection points.

Economic motivations entailed better prices, payment delay, bargaining power, access to credit and alternative markets. Adjei et al. (2017) and Repar et al. (2018) argued that once prices in

Vertical coordination strategic options	Population size	Proportionate	Sample size	Ahero	Kobura
Contractors	650	0.82	219	109	110
Processors	140	0.18	47	24	23
Total	790	1	266	133	133



**Table 2. Variables for analysis and expected signs**

Variable	Description	Measurements	Expected sign
<b>Dependent variable</b>			
Proportion	% of the marketed surplus	Continuous	
<b>Independent variable</b>			
<b>Farmer characteristics</b>			
Age	Age of household head in years	Continuous	-
Gender	Gender of the household head	Dummy	±
Experience	Sorghum farming experience in years	Continuous	-
Education	Formal education in years	Continuous	-
Off-farm income	Off-farm employment	Dummy	-
<b>Farm characteristics</b>			
Farm size	Farm size of the household in acres	Continuous	-
Site distance	Distance to sorghum collection point in kms/ mins	Continuous	+
<b>Economic motivations</b>			
Better prices	Higher prices from alternative markets	Dummy	+
Payment delay	Number of days to be paid	Continuous	+
Bargaining power	Negotiations on prices and quality	Dummy	-
Credit access	Credit access	Dummy	+
Alternative markets	Easiness to access alternative markets(easy, fair or difficult)	Three categories	+
<b>Institutional factors</b>			
Trust	Affective and cognitive trust (SD to SA)	5 likert scale	+
Technical services	Frequency in trainings per year	Continuous	-
Network externalities Neighbourhood effect	Relational networks between farmers and peers (SD to SA) Number of farmers in the radius of half a kilometre growing sorghum	5 likert scale Continuous	+ +
Type of VCSO	VCSO a farmer is involved in	Four categories	+
Enforcement level	Enforcement level of the target market (range from 0 to 100%)	Continuous	-

alternative markets are higher than in coordinated markets, farm enterprises tend to side sell. Malan et al. (2015) and Shumeta et al. (2018) stated that payment delays influence farm enterprises to side sell their produce. The study also theorized a positive relationship for better prices, payment delay, access to credit and alternative markets while high bargaining power could lessen the side selling behaviours of sorghum producers.

Institutional factors captured were trust, technical services in terms of frequency in trainings per year, social influence in likert, type of vertical coordination strategic options a farmer is involved in and the enforcement level of the target market in percentage. Bakucs and Ferto (2013), Wollni and Fischer (2015), and Shumeta et al. (2018) found that cognitive trust reduces written contracts and side selling action of the producers. The study hypothesized that trust reduces the likelihood of side selling lowering the extent of side selling to alternative markets. Frequency in trainings involves regular monitoring which the study thought could reduce the side selling behaviours of producers. Adjei et al. (2017) had revealed that regular monitoring regulate side selling of sorghum producers. Network externality between farmers and peers was presented in 5 likert scale and the study assumed the variable would influence side selling positively. If few farmers' chose to side sell their sorghum, they will influence their peers to side sell too. The type of vertical coordination strategic options a farmer is involved in will positively influence side selling while the level of enforcement of the target markets minimizes the extent of side selling.

### 3.6. Econometric modelling

To assess the drivers and extent of side selling among the small-scale sorghum farm enterprise owners along the different vertical coordination strategic options, 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 produce marketed. 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 which would have been used to estimate bounded dependent variables are truncated and censored regressions such as Tobit but, the values in the interval would not be feasible since the values were not 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

$$E(\gamma_i/x_i) = G(x_i/\theta), i = 1, 2, \dots, N \quad (1)$$

Whereby  $\gamma_i$  is the dependent variable and  $x_i$  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;

$$LL_i(\theta) = \gamma_i \log[G(x_i/\theta)] + (1 - \gamma_i)[1 - G(x_i/\theta)] \quad (2)$$

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

$$\theta = \arg_{\theta} \max \sum_{n=1}^N LL_i(\theta) \quad (3)$$

## 4. Results and discussions

### 4.1. Farmer and farm characteristics of the respondents

According to descriptive results shown in Table 3, the average mean age of the household heads was 47.83 years. This suggests that majority of the sorghum producers were young and fell within the active



**Table 3. Farmer and farm characteristics**

Variables	N	Mean	Std. deviation
Age of house hold head (years)	274	47.83	14.418
Household size	274	3.32	1.562
Education in years	274	9.65	3.956
Sorghum farming experience (years)	274	6.22	7.090
Land size	274	5.06	4.110
Credit (amount)	55	17590.9091	7810.06646

**Table 4. Categorical variables for respondents**

Variable	Descriptive	Frequency	Percentage
Gender	Male	156	56.9
	Female	118	43.1
Off-farm income	No	133	48.5
	Yes	141	51.5

population. This is because young producers are open to new interventions (Dlamini and Ortmann, 2019). The household size had three persons on average suggesting that majority of the households were a nucleus type of family system. The farmers had considerable literacy levels of 9.65 years on average. Majority of the sorghum producers had attained primary education. The level of education is believed to enhance decision-making (Cheelo, 2019) and influence producers' capability to read and retrieve information on sorghum innovations and market conditions (Adu, 2018; Abate et al., 2019).

The producers also had extensive experience in sorghum farming ranging from 1 to 23 years. The average sorghum experience was 5.83 years. The average size of farm owned and rented by the producers was 5.06. This implies that smaller sizes of land increase the managing ability of the household heads thus utilizing new ideas (Abate et al., 2019). Fewer of the sorghum producers (55) sought financial aid from institutions and the average amount of credit they received was Ksh. 17,590.91. Access to credit reduces issues related to finance allowing producers to purchase quality seeds and fertilizers and also utilize technologies which enable producers to produce quality products for output markets (Jebesa, 2019).

Table 4 shows the categorical variables of the respondents and it entails gender and off-farm income. With respect to gender of the household heads, 56.9% of the sampled respondents were male while 43.1% were female. This shows that more producers involved in production of sorghum were males than females thus taking up core roles in decision-making. Adu (2018) also found out that male producers were seen making decisions in their farm enterprises unlike their counterparts who help in production activities like planting, weeding, harvesting, threshing winnowing and marketing of sorghum.

According to the off farm income, 51.5% of the respondents had off-farm incomes whereas, 48.5% did not. This indicates that more than half had off-farm income which increases the liquidity of the farm's capital. De Bandt et al., (2017) and Dlamini and Ortmann (2019) inferred that off-farm income is a supplementary asset in the household used to obtain agricultural inputs for production.

**Table 5. Extent of side selling**

Variable	Coefficient	Robust standard error
<b>Farmer characteristics</b>		
Gender of HHH	-0.297	0.601
Age of HHH	-0.049	0.033
Years of schooling of HHH	-0.012	0.119
Years in sorghum production	0.242***	0.077
Other form of income	-1.988***	0.729
<b>Farm characteristics</b>		
Land owned and rented	-0.101*	0.057
Distance to collection point	0.045	0.039
<b>Economic motivations</b>		
Better prices	7.900***	1.912
Time one received payment	-0.187	0.117
Ease to get alternative markets	0.228	0.406
Credit	-1.950**	0.784
Level of bargaining	0.844***	0.284
<b>Institutional factors</b>		
Contract implementation	-0.0263	0.017
Neighbourhood effect	-0.540*	0.322
Extension contacts in 2019	0.291***	0.093
Network externalities	1.402***	0.534
Trust	-0.831**	0.329
Constant	0.238	2.288

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

#### **4.2. 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 producers along the different vertical coordination strategic options was achieved using Fractional Response Model. Logit regression was used to determine drivers motivating small-scale sorghum producers to side sell their produce before supplying them to their targeted vertical coordination strategic options. Ten against eighteen coefficients of the variables showed statistical significance of at least 10% thus indicating that most small-scale farmers side sold 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.

Table 5 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 their produce. The Pseudo R<sup>2</sup> was 0.709 indicating that about 71% of the producers opted for side selling. The constant was a positive showing that majority of the sorghum enterprises side sell their produce to alternative markets.

Sorghum farming experience in the study was assumed to have a negative relationship on side selling as experienced farmers would benefit from the targeted vertical coordination strategic options on resources and market and also lower producers transaction costs on search for markets. From Table 5, the results indicate that sorghum farming experience of the household head had a positive and significant influence on side selling of the sorghum enterprises. The variable was a contrast to our

postulation and was significant at 1%. It depicts that experienced farm enterprise owners side sold their produce to alternative markets. 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. (2018) who found out that the fully committed producers had more years of farming experience in coffee production than those who side sold.

Off-farm income had a negative influence on side selling and was significant at 1% significance level. Producers with other forms of incomes were found to be loyal to their targeted vertical coordination strategic options compared to those who had no other off-farm incomes. 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. (2018) who found out that those producers with off-farm income reduced side selling by 4% than those without off-farm income. Additionally, Wollni 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 5, the variable was found to have a negative significant relationship with side selling at 10%. This indicates that increase in farm size decreases the act of side selling. The reason would be because the farmers tend to incline to sell to their targeted vertical coordination 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 Wollni and Fischer (2015) also found out that the volume of coffee delivered to cooperatives will decrease at a decreasing rate to a point of 18.3 ha 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 owner's in the study area. The variable had a positive influence at 1% significance level. 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 consisted 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 enterprises were not satisfied with the attributes offered in the targeted markets. A similar finding was found by Goel (2014) 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 side selling at 5%. The result is a contrast to our expectations indicating that the more the amount of credit the sorghum enterprises obtained from their targeted vertical coordination strategic options, the lesser they tend to side sell. This motivates the farm enterprises to supply their produce to their targeted vertical coordination strategic options. It could be because the inputs offered by the targeted vertical coordination 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 Wollni

and Fischer (2015) and Shumeta et al. (2018) who reported that, producers with unsettled credit have a tendency 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 vertical coordination strategic options had a positive influence on side selling. This implies that the lower the bargaining powers of the producers, increases the incidences of side selling. This is in line with the study's expectations and was significant at 1%. 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 positive and significant effect on side selling at 10%. 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 their produce too. 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 neighbors. 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 vertical coordination strategic options. Results in Table 3 found a positive and significant effect of extension contacts on side selling at 1%. The positive sign indicate that sorghum producers who had more contacts with technical officer side sold their produce to alternative markets. 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 vertical coordination 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), Dondè et al. (2016), Wollni and Fischer (2015), and Shumeta et al. (2018) 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 vice if at all some of the producers practice side selling. The variable was significant and positively influencing side selling at 1%. 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 act 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 vertical coordination strategic options could be acting in their interests. From the results in Table 3, it was found to have a negative effect on side selling and had a significance of 5%. This indicates that the more the trust producers have on their targeted vertical coordination strategic options the lesser they are likely to side sell reducing side selling. Wollni and Fischer (2015) reported that trust increases the amount of produce delivered to cooperatives by 5%. Bakucs and Ferto (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., 2018) are in line with the above findings that cognitive trust of the producers reduces the likelihood of side selling.

## 5. Conclusions and recommendations

The study contributes to literature on the determinants of side selling behaviour of sorghum farm enterprise owners in Ahero and Kobura wards in Kisumu County. It takes account on farmer characteristics, farm characteristics, economic motivations, institutional factors as the drivers of side selling among small-scale sorghum producers. Results suggest that about 78% of the sorghum producers in Kisumu County side sold their sorghum despite them committing their produce to different Vertical Coordination Strategic Options. This study finds that farming experience, better prices from alternative markets, neighbourhood effect, frequency of contacts, low bargaining power and network externalities as the key factors for side selling. Whereas other forms of income, land size, credit access and trust reduced this vice of side selling. 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 by developing advanced information sharing systems and also incorporating them in decision-making. For bargaining power, farm enterprises should be integrated in setting the prices and quality which might sensitize small-scale farm enterprise owners to comply with the contract terms reducing the leaking of sorghum to alternative markets. Frequent monitoring is encouraged to create good relationship with the producers reducing side selling.

Additionally, Agribusiness firms and processors should buy sorghum on time especially after harvesting period to ensure purchase of quality produce from the processor. They should also offer a better price and be paid on time to prevent side selling behaviour among the farm enterprises. Similarly, they should set the lowest quantity of produce to be delivered to them in order to reduce the side selling behaviour. Lastly, the government should help in establishing legal frameworks on contract laws and enforcement mechanisms in order to curb the vice. Since side selling effect is becoming problematic, more studies should be done on the determinants of side selling in the different supply chains as the results obtained might not be applicable to all supply chains. Other studies should focus on measuring the transaction costs incurred by the farm enterprise owners than using the transaction features which was employed by the study.

### 5.1. Policy implications

The results indicate that much emphasis should be placed on trust between the buyers, their bargaining power and monitoring of farm enterprise in order to reduce the side selling behaviours of the farm enterprise owners. Trust encourages long-term relationships with the partners reducing side selling effect. This trust can be achieved through ensuring information flow between the buyers by developing advanced information sharing systems 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. Frequent monitoring is encouraged to create good relationship with the producers reducing side selling.

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