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Determinants of market participation and the institutional constraints: Case study of Kweneng West, Botswana

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For smallholder livestock farmers to benefit from their livestock, they need to fully participate in the market. This study identifies the determinants of market participation by smallholder livestock farmers in Botswana. The study used data collected from 132 smallholder livestock farmers in Kweneng West in 2007. A logit model was used to identify factors that determine whether smallholder farmers will participate in the market or not. The results indicate that the age of household head negatively and significantly affects market participation, implying that older farmers are less likely to participate in the market; planting crops increases the chances of market participation, as does the accessibility to market price information. The major limitation facing smallholder livestock farmers is the requirement that the animals should have a bolus (for traceability) and veterinary permits. In order to stimulate the participation of smallholder farmers in the market, policies aimed at promoting participation of youth in agriculture should be explored. In addition, policies should target service delivery improvement by all institutions involved in the marketing of cattle including those issuing cattle movement or veterinary permits. This will go a long way in increasing smallholders' income from livestock and hence improve their living standards.

Key words: Botswana, market participation, institutional constraints, transaction costs, logistic regression.

INTRODUCTION

Botswana's agriculture is dominated by livestock production which accounts for over 80% of agricultural gross domestic product (Statistics Botswana, 2015b). Livestock are raised under two production systems, namely communal and commercial systems, with the communal sector accounting for the majority (80%) of all cattle. Although the communal sector holds the majority of the country's cattle population, the market off-take rates in communal areas are lower than the commercial off-take rates (Statistics Botswana, 2015; Nkhori, 2004) as in other African countries (Enkono et al., 2013; Musemwa et al., 2010). Market participation in agriculture

is considered one of the most important contributory factors to poverty reduction in developing countries (Delgado, 1998; Ehui et al., 2009). Unfortunately in Botswana, the market off-take rate of cattle through formal markets remains relatively low at 8.26[1]% compared to 15.79% from commercial farming. The lower off-take rates in communal areas can be attributed to many factors. According to von Bach et al. (1998)

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[1] This is the average off-take rate for the years 1979 to 2004, excluding the years when data was not available (1991 – 1992 and 1994).

availability of marketable surplus and alternative income sources have been found to affect off-take rates. Alternative sources of income include participation in mixed farming, whereby farmers can sell crops or small stock to generate income (Enkono et al., 2013).

The low off-take rates have also been attributed to institutional constraints as well as the transaction costs involved in marketing cattle to formal markets (Kirsten, 2002). Transaction costs in smallholder farming are a result of differential access to assets and information asymmetries. According to Hobbs (1997), when producers are faced with high transaction costs they may not get the benefits of trade and thereby choose not to participate in the markets which subsequently results in low off-take rates. According to Mahabile (2013), determinants of transaction costs in southern Botswana were identified as herd size, age, wage, secure land tenure and availability of short term credit. However, private farmers were found to have better access to the market and therefore incurred less transaction costs, hence the higher off-take rates. Other than transaction costs, determinants of market participation for smallholder farmers include socio-economic characteristics such as alternative sources of income, household size, level of education, and employment status (Baldwin, et al., 2008) as well as technical and institutional factors such as market access (Lubungu et al., 2012).

Although the country's rural economy relies substantially on cattle farming as a source of livelihood, there is limited research on smallholder farmers' participation in the livestock market and little empirical evidence on institutional factors influencing beef cattle marketing in Botswana. Given this research gap, this study aims to determine the variables that influence market participation by smallholder cattle farmers in Botswana using Kweneg West as a case study, with emphasis placed on the institutional constraints that impede market participation.

A number of marketing channels exist for marketing of slaughter cattle in Kweneng West, both formal and informal. Informal cattle marketing channels include sales to individuals who slaughter cattle for ceremonial purposes such as weddings and funerals. Moreover, cattle can also be sold to other farmers as breeding stock or for paying of lobola (bride price). Formal markets include the butcheries and the Botswana Meat Commission (BMC). The butchery channel includes local butcheries and butcheries outside the area, mainly in Molepolole, (the district headquarters) and Gaborone (the capital) about 110 km from Letlhakeng, (the sub-district headquarters) Kweneng West. The nearest BMC abattoir is in Lobatse, about 180 km from Kweneng West.

The main marketing channel is through the Botswana Meat Commission (BMC), a parastatal under the Ministry of Agriculture (MoA), which was specifically set up to buy all livestock available for sale in Botswana. The BMC has a monopoly over exports of meat and live animals, and anybody who wishes to export the same should seek for permission from the BMC. Cattle arrive at the BMC through three main sources, direct from farmers who hire or provide own transport, agents and cooperatives. In recent years the BMC has also started purchasing live cattle from producing areas in order to stimulate supply to its abattoirs. In addition the BMC temporarily abolished the measles penalty which was 70% of the value of the animal, for animals found to be infected with measles at the time of slaughter. Another incentive for farmers to sell to BMC abattoirs was to increase prices by an average of 40%. The prices are now based on export parity to regional prices, particularly that of South Africa.

Despite the availability of the various marketing channels in the district, several institutional constraints also limit participation of farmers in these formal cattle marketing channels in Kweneng West. These constraints include the requirement that all cattle should have two permits for their movement from one livestock zone to another; one from the Department of Veterinary Services (DVS) and another one from the Botswana Police (BP). These permits are meant to ensure authenticity of ownership, that is, that the cattle indeed belong to whoever is selling them, and hence curb stock theft. However, logistical problems exist in that a farmer is required to make sure that both the DVS and BP officers are available at his/her farm at the same time. This task is very difficult to accomplish as the two offices have their own schedules. This obviously increases the farmer's transaction costs and ultimately limits his/her participation in the formal marketing channels.

MATERIALS AND METHODS

Study area

The study was carried out in Kweneng West, which is situated in the western part of Kweneng administrative district. Kweneng West has a population of about 47, 797 inhabitants (Statistics Botswana, 2015a). Letlhakeng, the sub-district headquarters is situated about 60 kilometres west of Molepolole and about 110 kilometres from Gaborone, the capital. Kweneng west comprises of a total of 24 official villages and settlements. The main economic activity in the area is agriculture. Due to erratic rainfall and high temperatures, coupled with poor soils and location in the sand veldt, the area is more suitable for livestock than arable farming. The sub-district has 6880 traditional agricultural holdings out of which 4751 (69%) have cattle, 5940 (87%) have goats, 1549 (23%) have sheep and only 1016 (15%) grow crops (Republic of Botswana, 2003). Thus, traditional agriculture in the sub-district is dominated by livestock especially goats and cattle.

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Table 1. Distribution of respondents in the study area.

Extension area	Frequency	Percentage (%)
Dutlwe	11	8
Ditshegwane	15	11
Khudumelajwe	20	15
Letlhakeng	13	10
Maboane	17	13
Motokwe	15	11
Salajwe	25	19
Takatokwane	16	12
Total	132	100

Source: Survey data.

The study area is composed of all the eight livestock extension areas in Kweneng West sub-district. The distribution of respondents in the eight extension areas is presented in Table 1.

Study design

The study used a quantitative research approach. Data collection was done through a cross sectional household survey with a structured questionnaire using face-to-face or personal interviews. This method was used as respondents do not have telephone lines or access to mail boxes and other elicitation methods were not possible. Face-to-face surveys have also been shown to achieve higher response rates than either telephone or mail surveys (Tourangean, 2004). Tough more costly and time-consuming (Kelley et al., 2003), face-to-face surveys were particularly advantageous to use in this case as the majority of the respondents were expected to be illiterate, and this method does not require the respondents to be able to read or write. The questionnaire was administered to a sample of 132 livestock farmers in Kweneng West.

Sampling and sampling techniques

The study used a multi-stage sampling procedure. In the first stage, a list of villages (extension areas) was purposefully selected in terms of population of cattle holdings and distance from Letlhakeng, the sub-district headquarters. In the second stage, livestock farmers were randomly selected using the random number table against a list of livestock farmers compiled using information obtained from the Department of Animal Health and Production in Letlhakeng.

Data collection

Primary data was collected using a structured questionnaire. The questionnaire was used to collect household information on household endowment or wealth, transaction costs and household demographic and socio-economic characteristics likely to influence the farmers' decisions to participate in beef markets. The third and last part of the questionnaire contained open ended questions which solicited farmers' views on the problems they face in marketing their livestock and the proposed solutions in order to stimulate livestock supply to marketing channels.

Theoretical framework

Model specification

In this study, the dependent variable is binary, that is, either the household participates or does not participate in the cattle market. A relevant statistical model when the dependent variable is binary is the logistic regression model. Following Uchezumba et al. (2009), the choice of binary logistic regression techniques was based on two reasons that is the technique can be employed to analyse the relationship between a categorical response variable and a set of both continuous and categorical variables. Furthermore the technique is best suited for modelling non-linear distribution, which is not appropriate with ordinary least squares (OLS). Following Uchezumba et al. (2009) and Gujarati (2003), a logistic regression model is specified as:

$$P_i = E(Y_i = 1/X_i) = \frac{1}{1+e^{-\left(\alpha_i + \Sigma_{i=1}^K \beta_i X_i\right)}} \tag{1}$$

Where P_i is the probability of household i participating in the market for cattle, Y_i is the level of participation by the same household i, Xi is a set of explanatory variables influencing the participation of household i in the cattle market and the β_i's are the parameters to be estimated.

The term $(\alpha_i + \Sigma_{i=1}^K \beta_i X_i)$ can be denoted as Z_i, so that Equation 1 becomes:

$$P_i = \frac{1}{1+e^{-Z_i}} \tag{2}$$

Given that the probability of participating in the market (P_i) is as given in Equation 2; then the probability of not participating in the cattle market (1-P_i) can be expressed as specified below:

$$\frac{1}{(1-P_i)} = 1 + e^{Z_i} \tag{3}$$

The odds ratio P_i/1-P_i is therefore given as:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} \tag{4}$$

Taking the logarithm of Equation 4, we obtain the logit model of the following form:

$$L_i = \ln\left[\frac{P_i}{1-P_i}\right] = P_0 + \Sigma_{i=1}^k \gamma_i X_i + \varepsilon_i \tag{5}$$

Where L_i is the logit and ε_i is the error term and the other variables are defined as before. By rearranging Equation 5 with the dependent variable in log of odds, the logistic regression can be manipulated to calculate the conditional probabilities using Equation 6 below.

$$P_i = e^{\left(P_0 + \Sigma_{i=1}^k \gamma_i X_i\right)} \tag{6a}$$

$$P_i = \frac{e^{P_0 + \Sigma_{i=1}^k \gamma_i X_i}}{1 + e^{P_0 + \Sigma_{i=1}^k \gamma_i X_i}} \tag{6b}$$

The partial effects of the discrete or categorical variables on the probability of household i selling cattle are determined by taking the partial derivative as specified in Equation 7.

Table 2. Description of explanatory variables.

Variable	Description	Expected sign
Household endowment		
ARAB	Size of arable land in hectares	+
HERD	Number of cattle owned	+
Farming	Annual farm income	+
Nonfarming	Access to non-farm income (=1, 0 otherwise)	+
OWNTRANS	Ownership of a mobile asset (=1, 0 otherwise)	+
SMLSTCK	Ownership of a small-stock (=1, 0 otherwise)	+/-
Transaction costs/ Information access		
DISTMKT	Distance to the nearest market centre (km)	-
DISTRD	Distance to the nearest tarred road (km)	-
PRICEINFO	Access to price information (=1, 0 otherwise)	+
MRKTNCRS	Attended marketing course (=1, 0 otherwise)	+
Household characteristics		
Gender	Gender (1 if male, 0 otherwise)	+
HHSIZE	Household size	+
AGEHH	Age	-
EDU	-	+
Primary	Attained primary education (=1, 0 otherwise)	+
Secondary	Attained secondary education (=1, 0 otherwise)	+
Tertiary	Attained tertiary education (=1, 0 otherwise)	+
YRSFARM	Number of years keeping livestock	+
Crops	Planted crops the last season (=1, 0 otherwise)	+
Market shock		
Died	Number of cattle that died in the last 12 months	+
Dependent variable		
CTSOLD12	Sold cattle in the last 12 months (=1, 0 otherwise)	-

Source: Survey data.

$$\frac{dP_i}{dX_i} = P_i(1 - P_i)\gamma_i \tag{7}$$

Essentially, the partial effects are calculated by taking differences of the mean probabilities estimated for the respective discrete variables, that is, when x=0, and x=1.

Empirical model - Determinants of market participation

To evaluate the determinants of market participation, the following general logistic regression model will be used:

$$Logit\,(P_i) = \ln(P_i/1 - P_i) = \beta_0 + \beta_i X_i + \cdots + \beta_n X_n \tag{8}$$

Where $\ln(P_i/1 - P_i)$ is the logit for market participation choices; P_i represents participation in markets; $1 - P_i$ is not participating in markets, and the X_i's represents covariates as previously stated. The empirical model, with the explanatory variables selected based on theory, is presented as:

$$\ln(P_i/1 - P_i) = \beta_0 + \beta_1 HE_i + \beta_2 TC_i + \beta_3 HC_i \tag{9}$$

The explanatory variables are grouped into three broad categories namely: household endowment (HE) variables, transaction costs (TC) variables and lastly, household characteristics (HC) variables based on economic theory and other empirical studies. The explanatory variables and their hypothesized signs are shown in Table 2 and are subsequently discussed. The dependent variable is CTSOLD12 – whether the respondent sold cattle in the last 12 months or not.

The size of the arable land (ARAB), herd size (HERD), availability of farm (FARMINC) and non-farm income (NONFARMINC) and ownership of a mobile asset (OWNTRANS) are hypothesized to positively influence a farmer's decision to participate in the market. All these variables may be viewed as proxies for wealth and therefore the larger the size of the arable land or the number of cattle owned the more likely the farmer is to participate in cattle marketing as these factors are likely to increase the farmer's access to loans. Similarly a respondent who has his/her own transport and/or has access to non-farm income is more likely to participate as transport ownership reduces cash outlays, hence promoting

market participation.

According to Heierli and Gass (2001), acquisition and ownership of productive assets can pave way for a family to participate in economic activities, hence the positive hypothesized sign for the household endowment variables. However, effect of ownership of small stock (SMLSTCK) on cattle market participation is ambiguous as small stock would readily provide cash relative to cattle, with lower transaction costs, resulting in limited participation in cattle market participation, but may also provide the necessary capital to participate in the cattle market.

Transaction costs can be expected to negatively influence market participation as they impose added cost burdens which impede market participation. Distance to a tarred road (DISTRD) and distance to the market (DISTMKT) are the main proxies for transaction costs and these are hypothesized to negatively affect market participation. That is, the further away a household is from a tarred road or the market, the higher the transaction costs as it will be more difficult and more costly to participate. The road condition is also expected to influence farmers' decision to participate. Poor state of roads and/or inadequate road networks hinder marketing efficiency (Randela et al., 2008). Farmers in highly remote areas with poor road infrastructure are likely to face high transaction costs and/or low prices per live animals and these factors will be a disincentive to market participation.

Information asymmetries and/ or lack of access to information may also hinder marketing efficiency and hence market participation as informational bottlenecks increase transaction costs as farmers incur increased search, screening and bargaining costs. According to Siziba et al. (2011) access to information about prices and market opportunities reduces risk perceptions and transaction costs and hence the variables PRICEINFO and MRKTCRS are hypothesized to positively affect market participation (Musah et al., 2014); hence a positive sign is hypothesized for these two covariates.

Household characteristics expected to influence market participation include age (AGEHH) and gender of the household head (GENDER), size of the household (HHSIZE), the level of education of the household head (EDU), and the number of years keeping livestock (YRSFARM). Market participation is expected to decrease with age; hence a negative sign is hypothesized. According to Musah et al. (2014) older farmers may be more risk adverse, and would therefore choose to retain their livestock for security rather than participate in the market. Younger farmers, on the contrary, are expected to be fully engaged in the market so as to enhance their quality of life (Musah et al., 2014). They may also have higher levels of education and subsequently higher socio-economic status, and thus more progressive and receptive to new ideas (Randela et al., 2008). Younger farmers will therefore have relatively lower transaction costs and will have a higher probability of market participation.

Male-headed households are more likely to participate in the market as cattle farming is considered a patriarchal activity. Female-headed households are therefore expected to have lower probability of market participation compared to their male counterparts. The household size represents the productive and consumption unit of the household (Makhura (2001). Under the traditional farming system with minimal technology, household members represent labour resources and thus the larger the household size the more productive the household and livestock production may exceed subsistence requirements resulting in an increase in marketed surplus (Martey et al., 2012) and therefore the likelihood to participate in the market. A positive relationship is therefore expected as in the study of Randela et al. (2008), Enete and Igbokiwe (2009) and Adeoti et al. (2014).

Education level of the household head (EDU) is hypothesized to increase the household's ability to access and utilize market information. According to Makhura et al. (2001), Randela et al. (2008) and Enete and Igbokwe (2009) education provides households with better production and managerial skills which could translate to increased market participation. Household with higher level of education will more likely know where to source information reducing information asymmetries and hence transaction costs thereby increasing possibility of market participation. Higher level of education is therefore expected to positively influence market participation. Experience in farming (YRSFARM) has a positive sign as experience in farming may indicate increased knowledge of livestock markets and experience in marketing, hence increased ability to utilize market opportunities and therefore increased probability of market participation (Egbetokun and Omonona, 2012). Active participation in crop production (CROPS) will provide a form of agricultural diversification and therefore reduced risk of food insecurity as crops will provide as alternative source of income and food to livestock thereby hence it is hypothesized that it will positively influence cattle market participation (Mwangi et al., 2015).

Market shocks such as cattle mortality (DIED) due to drought or diseases are likely to increase the likelihood of households selling cattle (Lubungu, 2016) as households try to avoid incurring further losses. Cattle mortality is therefore hypothesized to positively impact cattle market participation.

Determinants of market participation of smallholder farmers

Table 3 presents the summary statistics of the explanatory variables in the regression model. The majority of respondents were male (81.8%) and had no formal education. The age of the respondents ranged from 32 to 89, with an average of 56 years. The average household size was 3.3, with the majority of households (61.4%) engaged in crop farming. About 86% of the respondents had income from non-farm sources and it was the main source of income as it was over four times more than the average farm income.

Farm income is derived from sale of livestock or livestock by-products whereas non-farm income is derived from formal employment, rental, remittances, pension, sale of veldt products or proceeds of a business. The average distance to a tarred road is 14.15 km, whereas mean distance to the nearest marketing outlet was found to be 124.23 km. The respondents owned on average, 10 hectares of arable land and 57 heads of cattle. The majority of the respondents had access to price information (74%), but only 5.3% had ever attended a marketing course. Farmers lost about 5 cattle on average, and as many as 30 per year through various means. Only 38% of the respondents have a truck or van which can be used to transport their cattle to the market.

The results of the determinants of the probability of market participation from the logistic regression model are shown in Table 4. The binary logistic model was tested for and corrected from common regression analysis problems, that is, multicollinearity, heteroscedasticity and model fit and specification errors to ensure the model is correctly specified. The mean variance inflation factor (VIF) analysis was 1.67, with the largest VIF being 3.10. Since none of the VIF's were above 10, the model did not present any multicollinearity problems. Heteroscedasticity was corrected for by estimating Huber-White robust standard errors. The Hosmer and Lemeshow Goodness-of-Fit test gave a p-value of 0.798, implying that the model estimates fit the data very well. The Hosmer and Lemeshow Goodness-of-Fit Test is computed from the Pearson chi-square distribution with $p= 0.798$, we fail to reject the null hypothesis that there is no difference between the observed and predicted values of the dependent variable. The results indicate that age of the household head (AGEHH), attaining tertiary education (TERTIARY), farming experience, (YRSFARM), participation in arable farming (CROPS), farm income (FARMINC), distance from the farm to the market outlet (DISTMKT), attendance of a marketing course (MRKTCRS) and market shock of cattle

Table 3. Summary statistics of the explanatory variables (N = 131).

Variable	Mean or proportion	Minimum	Maximum	Std. Dev.
Household endowment				
ARAB	9.72	0	48	8.85
HERD	50.33	2	364	57.49
Farming	9418.13	0	90000	14246.75
Non farming	0.86	0	1	0.35
OWNTRANS	0.37	0	1	0.49
SMLSTCK	0.58	0	1	0.50
Transaction costs/ Information access				
DISTMKT	123.53	1	390	123.58
DISTRD	13.34	0	50	12.11
Price info	0.73	0	1	0.44
MRKTNCRS	0.05	0	1	0.23
Household characteristics				
Gender	0.82	0	1	0.39
HH size	3.31	1	11	1.92
Age HH	56.34	32	89	14.50
Education				
None (Reference)				
Primary	0.12	0	1	0.33
Secondary	0.10	0	1	0.30
Tertiary	0.12	0	1	0.32
YRSFARM	24.24	1	67	16.14
Crops	0.61	0	1	0.49
Market shock				
Died	4.37	0	27	5.10
Dependent variable				
CTSOLD12	0.82	0	1	0.39

Source: Survey data.

mortality (DIED) influence cattle market participation.

The logistic regression results show that age of the household head (AGEHH) and attendance of a marketing course (MRKTCRS) were statistically significant at the 10 percent level, and had a negative relationship with market participation. Having tertiary education (TERTIARY) reduced the probability of market participation 0.077 times compared to households without any formal education. Farming experience (YRSFARM) was found to increase participation in the market as hypothesized, with the probability of participation increasing by 1.050 times with each additional year of farming experience. As hypothesized, active crop cultivation (CROPS) positively impacted market participation and was highly significant. The odds ratio show that, holding all other explanatory variables constant, we can expect a 7.809 times increase in the probability of market participation for farmers who grow arable crops, compared to those who only practice cattle husbandry. Availability of farm income (FARMINC) was found to be positively related to market participation and is statistically significant at the 10 percent level. Contrary to the prior expectations, DISTMKT has a positive impact on market participation, whereas MRKTCRS has a negative effect. As hypothesized, the coefficient for the market shock DIED was positive and significant at the 10 percent level.

The following explanatory variables were not statistically significant: gender (GENDER), Primary or Secondary education, household size (HHSIZE), access to non-farm income (NONFARMINC), total arable land (ARAB), total number of cattle (HERD), ownership of mobile asset (OWNTRANS), ownership of small stock (SMLSTCK), access to price information (PRICEINFO) and distance from the farm to the nearest tarred road (DISTRD).

Institutional constraints

There are a number of requirements that a farmer should meet before selling cattle to the BMC and other market outlets. These requirements include both a Police and DVS movement permits. At the time of the survey, all these requirements applied to the BMC only. Farmers selling to other market outlets were only required to have a Police permit. Before farmers can sell their animals to the BMC they are required to apply for a quota which indicates the number of cattle they intend to sell, their origin and their brand. As indicated in Table 5, of those respondents who participated (N=108) in the market 5% encountered problems in fulfilling the BMC quota application requirement. However, of those who did not participate

Table 4. Factors Influencing participation in the cattle market.

Variable	Parameter estimate	Odds ratio
Gender	0.126 (0.900)	1.134
HH size	-0.084 (0.149)	0.919
Age HH	-0.065 (0.027)**	0.937
Edu		
None (Reference)	-	-
Primary	0.416 (1.076)	1.516
Secondary	-1.064 (1.374)	0.345
Tertiary	-2.561 (1.509)*	0.077
YRSFARM	0.048 (0.031)*	1.050
Crops	2.055 (0.706)***	7.809
ARAB	0.032 (0.035)	1.033
Herd	0.009 (0.013)	1.009
Farming	0.0001 (0.00008)*	1.000
Nonfarming	0.475 (0.768)	1.608
OWNTRANS	-0.894 (0.828)	0.409
SMLSTCK	-0.343 (0.722)	0.709
DISTMKT	0.008 (0.003)***	1.008
DISTRD	-0.033 (0.025)	0.968
Price info	0.796 (0.743)	2.216
MRKTCRS	-2.659 (1.279)**	0.070
Died	0.188 (0.115)*	1.207
Constant	0.911 (2.027)	-
N	130	-
Likelihood Ratio chi^2 (19)	40.18	-
Prob > chi^2	0.003	-

*, **, ***:Results statistically significant at the 10, 5 and 1% level, respectively (Source: Survey data).

Table 5. Institutional constraints to market participation.

Requirement	Market participants (N=108) (%)	Non-participants (N=24) (%)
Bolus	27 (25)	8 (33)
Police permit	27(25)	7 (29)
BMC quota	5 (5)	9(38)
Total	59 (55)	24 (100)

Source: Survey data.

in the market, 38% reported the quota requirement as hindrance to market participation.

For the DVS permit to be given out, the animal must have a bolus inserted in its rumen that indicates the owner and the origin of the animal. The bolus requirement was noted as a hindrance to market participation by 25% of the market participants and 30% of the non-market participants. The local police also have to give a certificate of clearance which shows that the cattle indeed belong to the owner. Only 25% of the market participants found the police permit requirements constraining their level of market participation, while 29% of non-participants cited it as a hindrance to their participation. Of the 74 farmers who indicated that they sold cattle to the BMC, the majority (53%) indicated that they did not have any problems in

meeting these requirements. However, a sizable number (47%) indicated that they had difficulties in meeting these requirements. As indicated in Table 6, the most common institutional difficulty cited by farmers who had problems meeting requirements for selling to the BMC was the bolus requirement, while about a quarter of the respondents indicated that the DVS and Police Permits requirements gave them problems when trying to sell to the BMC. The least problem encountered by farmers who sold to the BMC was quota application.

The bolus requirement was indicated as a problem by a sizeable number (46%) of the farmers who participated in the market. The dysfunctional LITS increased farmers' transaction costs and affected their operations significantly in a number of ways. One of

Table 6. Difficulties in meeting BMC requirements (N = 74).

Frequency/Variable	Bolus	DVS-permit	Police Permit	BMC Quota	Total
More frequent	10	1	3	5	19
Frequent	8	7	8	0	23
Less frequent	28	16	14	0	58
Total	46	24	25	5	100

Source: Survey data.

the challenges was the reliability of the system to correctly capture farmers' details. In some instances, the previous owners' details were not sufficiently erased when boluses were reused and hence the farmer could not be certain that all his animals with a bolus had the correct identification data. In addition, the bolus readers were usually dysfunctional or had no power which hindered issuance of permits required for farmers to sell their cattle to the BMC. Farmers selling to the BMC encountered additional problems because they have to simultaneously arrange for a quota at the BMC, DVS technical assistant and the Police for the issuance of permits. This proved a daunting challenge to farmers as at times the DVS and the Police were not available at the same time. According to FAO (2013), BMC estimates that over 700,000 cattle are excluded from being sold because of the LITS problems.

RESULTS AND DISCUSSION

As hypothesized, the decision to participate in the livestock market is negatively impacted by age of the household head (AGEHH). This observation concurs with other empirical findings (Randela et al., 2008; Musah et al., 2014) and implies that households with the older household heads are less likely to participate in the market. Though counterintuitive, tertiary education reduces the probability of participation in the livestock market. One plausible explanation is that with high level of education the farmer has farm management skills and may operate as commercial entities, hence market participation is scheduled. The positive relationship between market participation and DISTMKT seems counterintuitive as this implies that farmer propensity to participate in livestock markets increases with remoteness. However, one plausible explanation may be that there is ease of access to the markets as the maximum distance to the nearest tarred road is only 50 km. A good road network has been found to positively influence market participation (Adeoti et al., 2014). Another possible explanation may be that the farmers sell to the BMC through BMC marketing agents who travel to the farmers' holdings to purchase livestock. The negative sign for MRKTCRS also seems counterintuitive as it implies that farmers who underwent a marketing course are less likely (0.070 times) to participate in the market. As expected, farmers who experienced market shocks in the form of cattle mortality (DIED) are 1.207 times more likely to participate in the livestock market than those who did not experience a market shock of cattle dying. These results reiterate those of Lubungu (2016) who found that

market shocks as a result of family member or cattle mortality increases the likelihood of households participating in the cattle market.

CONCLUSION AND RECOMMENDATIONS

The determinants of market participation of smallholder livestock farmers are age of the household head, household farm income, arable farming, attendance of marketing course and cattle mortality. In order to promote market participation of smallholder cattle farmers it is important for the government to continue to invest in agricultural youth programs which promote the involvement of younger and presumably educated farmers who will actively participate in the market and perhaps commercialize their operations. A mixed-farming model should be promoted as a way of reducing risk and encouraging livestock market participation. Though cattle mortality promotes market participation, government should continue to subsidize livestock feed and vaccines to assist farmers to mitigate the adverse drought and disease outbreak impacts so that they get optimal returns for their cattle. The most important institutional constraints were the bolus and police permit requirements for cattle sale. However, these requirements posed minimal difficulties according to farmers, possibly since these measures also curb livestock theft.

Conflict of Interests

The author has not declared any conflict of interests.

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