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Determinants of commercial orientation and the level of market participation by women maize farmers in Eswatini

A case study of the Highveld region

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SA-TIED Working Paper #71 | September 2019

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Abstract: Eswatini's agricultural and industrial sectors have over the years undergone an evolution as a result of wage employment. This has altered the gender division of agricultural labour. Where previously the nature of farming was gender-specific, women are now the *de facto* farm managers. On the one hand, this has resulted in an increased workload and greater economic hardship among women. On the other hand, it has provided an opportunity for women to improve household income and the standard of of living through commercialization. This paper uses primary data collected from 191 farmers in 6 communities in the Highveld region. The Heckman two-stage procedure is used to identify factors influencing commercialization. The results show that age, education, household and farm size, household assets (including land, livestock, communication devices, and transport assets), social capital, price, nonfarm income, savings, and credit have an impact on market participation. Therefore, policies geared towards improving extension, financial services, rural infrastructure, and market prices could increase the market participation of women.

Key words: commercialization, Eswatini, Highveld, maize, market participation, women farmers

JEL classification: C3, O2, Q1

Acknowledgements: I gratefully acknowledge the guidance, comments, and suggestions provided by Moraka Makhura and Selma Karuaihe.

1 Introduction

Agriculture is the backbone of Eswatini's economy. It is the cornerstone of the country's economic growth and development, as it contributes 11 per cent towards gross domestic product, employs 70 per cent of the population, and generates merchandise exports (Ministry of Agriculture (MOA) 2016). The sector is characterised by small-scale farmers, especially women. This is due to the migration of males from rural to urban areas to participate in wage employment, which has altered the traditional division of labour in both the industrial and the agricultural sectors, re-distributing decision-making and labour responsibilities (Oladejo et al. 2011). Women now provide between 60 and 80 per cent of agricultural labour in Africa (Sofa Team and Doss 2011), thus contributing to household and national food security. These changes are paramount to an understanding of women's integral role in agriculture in developing countries like Eswatini.

As well as being the new agricultural decision-makers, women now control resources in the rural economy and have contributed to increased demand in input markets for commercial hybrids and genetically modified seeds, inorganic fertilisers, pesticides, and herbicides. Such high-value products are expensive, and financial services such as loans mand credit provide farmers with the power to spend in input markets (Shewaye et al. 2016). Similarly, increased demand for farm implements and machinery has led to advances in agricultural technology.

Yet, despite their contribution to Eswatini's agricultural economy, women experience dauting constraints on crop production and market access, not to mention a vastly increased workload. According to Oladejo et al. (2011), women farmers have not been recipients of sustainable development assistance. Women hardly own land in Eswatini, where land policy permits women to acquire land only through their male relatives, who represent them during the *kukhonta* process (acquiring land through the chief). This hinders the production process, as land is the primary factor of production. Furthermore, limited rights to Swazi Nation Land (SNL) affect cash crop production, as land cannot be put up as collateral for securing credit, which is essential for purchasing farm inputs for cash crop production (Hill and Vigneri 2011). In addition, women

farmers have little or no contact with extension personnel, as the latter are male-dominated and male-oriented in approach (Hill and Vigneri 2011), with the result that many important extension services—such as training and information on new and improved technologies, crops, and markets—fail to reach women farmers (Conley and Udry 2010).

The above shows that participation in commercial agriculture has a gender-differentiated impact on farming households. Hence, treating farmers as a homogeneous group of stakeholders is no longer meaningful (World Bank 2017) and, in order to support its efforts to achieve agricultural development goals, economic growth, and food security, Eswatini's government needs to build on the contributions that women make and take measures to alleviate the constraints that impact on them. Studies such as Alene et al. (2008), Jagwe (2011), and Makhura (2001) have identified high transaction costs as one of the key reasons for smallholder farmers' failure to participate in markets. However, these studies do not take into account the variety of effects such factors can have and lack essential information on other market barriers that hinder market participation by women farmers. In addition, few studies have been conducted on market participation by women in the maize sector or empirically investigated the factors that influence commercialization. This paper therefore seeks to determine the factors that influence the market participation of women maize farmers in Eswatini.

The remainder of the paper is organised as follows: Section 2 provides an overview of maize production in Eswatini and defines the terms and concepts used in the study. Section 3 describes the methods and procedures employed. Section 4 presents and discusses the findings. Section 5 concludes and presents study recommendations.

2 Women in agricultural commercialization

This section begins by defining the characteristics of a woman farmer, followed by an overview of the maize industry and the concept of commercialization.

Traditionally women are regarded as homemakers who manage and coordinate household affairs and activities. This is seen in their engagement in household chores as well as in their care of young and sick relatives (Omondi 2015). As a result, male and female farmers are distinguished in terms of the types of crops they grow. While men, who are responsible for providing household income, must grow cash and export crops (Doss 2001), women, who are responsible for feeding and caring for the family, tend to grow subsistence crops (Hill and Vigneri 2011; Kumar 1987). As well as having different endowments from their male counterparts, women have limited access to resources and consequently a low asset base. Therefore, women can be considered as smallholder, resource-poor, and peasant farmers (Mmbando 2014). Nevertheless, women farmers can be defined as *de facto* farm managers, as they are increasingly involved in agricultural decision-making and crop production and perform male tasks.

Eswatini's tenure system follows a dualistic pattern. Both SNL and Title Deed Land (TDL) influence the development and performance of the agricultural sector, as they affect land ownership and rights. TDL is privately owned by companies and individuals, whilst SNL is held in trust by traditional authorities for the Swazi people. Maize production occurs on both tenure systems, while subsistence farming is on SNL and commercial farming on TDL (Dlamini and Masuku 2011). Maize is predominantly grown in rural areas and is the staple food of the Swazi people, forming an integral part of their diet, tradition, and culture. Maize production covers 80 per cent of the total land under crop production (MOA 2016). Of the four regions of Eswatini, the Middle-veld produces the most maize (45 per cent) and the Lubombo Plateau the least (4 per

cent). The Lowveld and Highveld contribute 23 and 28 per cent of total production, respectively (National Maize Corporation (NMC) 2016). About 90 per cent of maize is grown on SNL.

2.1 Commercialization

Commercialization can occur either on the input or the output side in terms of increased use of inputs or increased market surplus. According to Pingali and Rosegrant (1995), market-related activity is the result of a shift in market orientation from subsistence to semi-commercial and, finally, a fully commercialised system. The authors further state that a farmer's objective under a subsistence system is mainly food security and is achieved through own production of inputs such as retained seed, while a semi-commercial system focuses on generating marketable surplus through a mix of traded and non-traded inputs. On the other hand, the farmer's objective in a fully commercialised system is profit maximization, which is obtained through market-produced inputs.

There are several dimensions to commercialization. The first relates to whether a farm participates in the market by selling its produce, i.e. the growing of crops for sale in output markets (Poulton et al. 1998). Latt and Nieuwoudt (1988) referred to it as market participation in which farmers shift towards increased production with the sole objective of exchanging goods and services in output markets. Key et al. (2000) defined commercialization as the process in which farmers produce mainly for sale. The driving factor identified for commercialization by all these authors is market orientation. Therefore, agricultural commercialization refers to a shift from production for consumption to market-oriented production that ensures the sale of produce (Omiti et al. 2009). This not only increases the market share of agricultural output but also leads to higher productivity, quality, and specialization of labour (Boughton et al. 2007). Market participation can lead to reduced food prices due to increased market competition, which lowers food processing and market costs (Jagwe 2011). This improves the overall welfare of Swazi women farmers by increasing their purchasing power for food as well as re-allocating limited household income.

According to some studies, the probability of engaging in output markets is determined by the level of commercialization (Omiti et al. 2009; Seyoum et al. 2011). This refers to the percentage value of the quantity sold by a farmer to total farm production. Seyoum et al. (2011) further refer to the degree of market engagement, where the quantity of produce sold is a measure of market participation. Hence, the intensity of market participation relates to the volume of goods traded in the market. Thus, quantity sold is an important aspect of commercial agriculture.

Determinants of commercialising subsistence agriculture

Socio-economic characteristics: Age, education, and household size all have an effect on the commercialization of agriculture. Younger farmers are expected to be more dynamic in terms of new ideas and innovations, while older farmers are more able to overcome transaction costs as they are more experienced and have a larger pool of trading partners (Makhura 2001). Similarly, Randela et al. (2008) used age as a proxy for farming experience. Human capital is captured by the household head's educational level. It represents the skills and expertise of a farm household. Makhura (2001) argues that household size can represent either the productive or the consumption units of the household. Hence, larger households represent an increased labour supply for engaging in farm activities. In contrast, Lapar et al. (2003) stated that larger households may be under pressure to ensure food security.

Physical household assets: Several studies show that resource endowments owned by the household are key drivers of commercialization (Asfaw et al., 2012; Boughton et al. 2007). Productive assets facilitate engagement in economic activities and lead to increased agricultural productivity (Heierli and Gass 2001). Household assets include land, livestock, communication

devices, and transport assets. Asset holdings play a vital role in determining the quantity of output produced. They also assist in overcoming market barriers, as they act as buffers to production and market shocks, which might otherwise serve as barriers to entering the market (Kirui 2013).

Social capital: Randela et al. (2008) defined social capital as a pool of social networks that provide farmers with opportunities to engage in output markets. Sharp and Smith (2003) stated that social capital is a form of collective action that involves being part of farmers' groups, cooperatives, and associations. According to Randela et al. (2008), being part of such groups leads to the dissemination of information regarding prices, markets, and farming technologies. In addition, the authors found that social organizations strengthen the bargaining and lobbying power of farmers, leading to improved coordination and cooperation in reducing market inefficiencies.

Transaction costs (TCs): Hobbs (1997) identified types of TCs in the marketing of agricultural products. These include information costs associated with searching for markets and trading partners. The majority of farmers are in remote rural areas that are far from towns and consumers. This leads to high search and transport costs. In addition, once the consumer has been identified, negotiation and bargaining costs erupt because of information asymmetries concerning market prices. Furthermore, farmers must specify the terms of exchange between parties, which increases information costs. Lastly, the author identified monitoring and enforcement costs, as farmers need to ensure that parties meet the terms of exchange. These costs explain why some farmers engage in output markets while others do not.

Product characteristics: Product characteristics are the attributes that identify a specific product. These include price, size, quantity, and appearance. Komarek (2010) found output price to have a significant impact on banana market participation in Uganda, in that high output prices serve as an incentive to farmers to engage in agricultural markets, whereas low prices discourage participation. Quantity produced has also been identified as a driver of commercialization. Once farmers have attained self-sufficiency, higher yields ensure marketable surplus.

3 Methods and procedures

This section presents the study area, sampling procedure, data sources, and analytical methods.

The focus of the study was on the Highveld region. This district is situated in the northwest of the country (at 26° 00' S 31° 30' E), bordering Eswatini's Lubombo and Manzini districts in the southeast and the southwest, respectively. The Highveld comprises 14 constituencies, the administrative centre and capital city being Mbabane. The region covers an area of 3,569 km^2 and houses about 300,000 Emaswati (MOA 2016). Annual average maximum and minimum temperatures in the district are 22 and 11° Celsius, respectively, with average rainfall of about 140 cm.

A multi-stage sampling procedure was employed in the study. The first stage involved purposive selection of the Highveld based on preceding knowledge of its being one of the largest producers of maize in the country with women at the forefront of production. The second stage involved the selection of six communities—namely, Nsingweni, Maphalaleni, Endlozini, Sitseni, Kasiko, and Motjane—on the basis of their ability to produce surplus. The last stage involved the random selection of male (61) and female (130) farmers from the six communities, making a total of 191 farmers. Although the study is on women, men were also explored to generate supplementary data. Primary data was collected from farmers in the six communities using semi-structured questionnaires. A farmers' survey and key informant interviews were used to capture information

on socio-economic characteristics, assets, social capital, market, and institutional and production factors. Household heads were also interviewed. Additional data were obtained through informal discussions and personal observations in order to support the data obtained from farmers. Furthermore, literature and other secondary data sources were reviewed. A pilot study was conducted to test whether the survey questions were clear, appropriate, and relevant to the study. Three enumerators who were fluent in the local language and understood the Swazi way of life were trained and assisted in the data collection.

3.1 Econometric estimation

The study used Heckman's (1979) two-stage procedure to identify factors influencing market participation. Unlike other models, such as the Tobit and double-hurdle, selectivity models such as Heckman's account for the selection problem (Makhura 2001). Of the 191 respondents, 62.3 per cent participated in the maize market during the 2016/17 marketing season and the rest did not. Therefore, selection bias was expected, and the Heckman two-step procedure was ideal to handle this problem. First, the Probit model is used to determine the probability of selling in the market, as shown below:

$$\Pr(Y_i = 1|x_i, \alpha) = \boldsymbol{\Phi}\big(h(x_i, \alpha)\big) + u_i \qquad (1)$$

Where:
Y_i = indicator variable equal to unity for a household that sold maize
X_i = vector of factors affecting market participation
α = coefficients to be estimated
$\boldsymbol{\Phi}$ = distribution function
U_i = error term.
The variable Y_i assumes the value of 1 if the marginal utility a household (i) gets from participating in the market is greater than 0, and 0 otherwise, as shown below:

$$Y_i^* = \alpha x_i + v_i \quad (2)$$

Where Y_i^* is the latent variable for the utility the household gets from participating in the maize market and the error term is $V_i \sim (N, 1)$, hence:

$$Y_i = 1 \; if \; Y_i^* > 0 \quad (3)$$

$$Y_i = 0 \; if \; Y_i^* \leq 0$$

The second stage uses a regression model as below:

$$Z_i = X_i\beta + \varepsilon_i \quad (4)$$

Where Z_i represents the quantity of maize sold and X_i is the vector of independent variables influencing the intensity of market participation, while β is the vector of coefficients and ε_i is the error term.

However, the regression model produces biased results, since error terms from Probit and Ordinary Least Squares (OLS) models are correlated such that $corr(u_i, \varepsilon_i) = \rho$. To correct for bias, lambda (inverse Mill's ratio), which was calculated from the Probit regression, is incorporated into the OLS model. As a result, the equation is specified as follows (Greene 2003):

$$E[Z_i | Y_{iZ} > 0] = X_i\beta + \rho\sigma_s\lambda_i \quad (5)$$

Where X_i is the determinants of the extent of commercialization, β is the vector of coefficients, and σ_s and σ_u are the standard errors for regression and selection models, respectively. λ_i represents the inverse Mill's ratio specified as (Siziba et al. 2011):

$$\lambda_i = \frac{\phi\,(Z_{iY}/\sigma_u)}{\Phi\,(Z_{iY}/\sigma_u)} \quad (6)$$

ϕ and $\boldsymbol{\Phi}$ are the density and distribution functions, respectively.

Chow test

The Chow test is used to determine whether the relationship between the dependent and explanatory variables is the same between groups and site-specific models, and therefore whether pooling or separating the model is preferable. Since the data were collected from two groups, it was necessary to determine whether it was appropriate to estimate a pooled sample model or split the data into gender-specific models. This study used Chow's seminal test to assess whether data from male and female farmers were significantly different (Chow 1960). The null hypothesis was that there was no structural change across male and female sub-samples.

$$H_0 = \beta_f = \beta_m \quad (7)$$

To estimate the Chow test, the pooled sample was split into two sub-samples, namely male and female farmers, where the residual sum of squares was obtained for both restricted (pooled sample) and unrestricted (sub-samples) models, as shown below:

$$F^* = RSSp - \frac{\frac{(RSSf+RSSm)}{P}}{(RSSf+RSSm)/(n-2p)} \quad (8)$$

Where:
F^* is the test statistic
RSS_p= residual sum of squares for the pooled sample
RSSf = residual sum of squares for the female sub-sample
RSSm = residual sum of squares for the male sub-sample
P = number of parameters in the model.

4 Characteristics of sampled households

This section compares male- and female-headed households and discusses the differences between market participants and non-participants with respect to their socio-economic, assets, and institutional characteristics. The t-test was used to test for differences in means for individual variables, while the chi-square test was used to test for association. Also, to test whether it was appropriate to pool or split models into male and female farmers, the Chow test was constructed.

Table 1 presents the Chow test results where the computed F* statistic of 2.40 was greater than the tabulated F statistic 1.97 at the 5 per cent significance level. This resulted in the rejection of the null hypothesis that the coefficients were equal between male and female farmers and the adoption of separate models for male and female farmers. This implies the need to take due care when introducing development programmes and support services—to take account of the differences that exist among men and women farmers in Eswatini. The observation supports the posture of this study to focus on the market participation of women maize farmers.

Table 1: Chow test

RSS_p	RSS_f	RSS_m	F^*	F (P, n-2p)	Decision
101760.27	3227.05	51706.22	2.40	1.97	Separate data

Source: Author's compilation.

4.1 Descriptive statistics

Descriptive statistics of the sampled maize farmers are presented in Table 2. Household characteristics varied significantly between male and female farmers. Specifically, male farmers were nine years older than their female counterparts. This age gap represents the aging agricultural labour force, which may not understand the benefits of agricultural commercialization. Also, male farmers were more literate than female farmers, as they had attained, on average, the secondary level of education, while the latter had only primary education. A possible explanation for the relatively high literacy level among male farmers is that they were accorded educational preferences over females in the past.

Table 2: Descriptive statistics for testing for differences in means between male and female maize farmers

Variable	Male farmers (61)	Female farmers (130)	Pooled sample (191)	
	Mean	Mean	Mean	T-value
Socio-economic characteristics				
Age	56.39	48.63	51.11	4.26***
Education	3.25	2.88	2.99	4.74***
Household size	7.08	6.94	6.98	0.41
Household assets				
Land	1.00	0.23	0.48	-20.74***
Livestock	0.62	0.58	0.60	-0.50
Tractor	0.016	0.062	4.7	1.69*
Working radio	0.72	0.61	0.64	-1.58
Mobile phone	0.57	0.96	0.84	-5.87***
Donkey/ox cart	0.52	0.32	0.39	-2.63***
Vehicle	0.62	0.25	0.37	-5.03***
Bicycle	0.34	0.25	0.28	-1.25
Institutional factors				
Farmers' group	0.61	0.45	0.50	-1.99**
Marketing information	0.56	0.45	0.49	-1.33
Access to credit	0.67	0.43	0.51	-3.23***
Extension services	0.71	0.53	0.59	-2.37**

*** p<0.01,** p<0.05,*p<0.1

Source: Author's compilation.

Ownership of certain household assets—namely land, mobile phone, donkey/ox cart, tractor, and other vehicle—was significantly different between male and female farmers. Hence, differences in asset ownership explicitly raise inequality issues among men and women. Most assets owned were skewed towards male-headed households. For instance, less than 30 per cent of female farmers owned land in the region. Women rarely owned land but had access to it through their husbands or male relatives. Again, transport assets were male-dominated, as they would have either the means to purchase vehicles due to salaried employment or the manpower and skill to build and manoeuvre donkey/ox carts. However, female-headed households owned more tractors, as these could be purchased through women's savings groups, operated by hired labour, and hired out to other homesteads during the ploughing and harvesting seasons. Tractors therefore worked out cheaper in the long run, as well as constituting both a business and a transport asset. In addition, over 80 per cent of female farmers owned mobile phones. This may be explained by the younger female age-group, which was more receptive to new ideas and technology.

More than 60 per cent of male farmers either belonged to farmers' organizations or had access to credit facilities and extension training, compared with less than 50 per cent of female farmers. Access to credit facilities may aid in the procurement of farm inputs and mechanization. In addition, access to training services may imply better accessibility to information on production practices and improved technologies, while membership in farmers' groups may lead to better negotiating and bargaining power.

Summary statistics of the variables used in the analysis

This sub-section presents a summary of statistics for the variables included in the regression as well as the significance level of tests of difference between means for each variable for market participants and non-participants.

Demographic characteristics: Out of a sample of 191 respondents, 62.3 per cent participated in the maize market as sellers, whilst 37.7 per cent did not. All variables varied significantly between participants and non-participants, as shown in Table 3. Market participants were approximately 3 years younger, were more educated, and had larger households. This could imply that participants

were more progressive and receptive to new ideas, and better understood market dynamics as well as the benefits of commercialization. Also, larger households may have a larger labour force to produce marketable output.

Table 3: Demographic characteristics of maize farmers in the Highveld

Variable	Participants (n=119)		Non-participants (n=72)		
	Mean	Std	Mean	Std	T-Value
Age (years)	49.53	10.85	53.72	12.76	2.33***
Education (level)	3.33	1.11	2.44	1.29	-5.03***
Household size (number)	7.70	2.23	5.81	1.82	-6.38***

*** p<0.01,** p<0.05,*p<0.1

Source: Author's compilation.

Institutional factors: Over 60 per cent of the sampled households had access to credit, extension services, and marketing information as well as belonging to farmers' organizations (Table 4). This resulted in significant differences between participants and non-participants. Availability of credit implies that market participants were able to purchase farm inputs, thus increasing the likelihood of market participation. Access to marketing information may result in better quality produce and marketing decisions, which also positively influence market engagement. In addition, membership of farmers' groups implies that maize sellers were able to spread their fixed TCs and strengthen their bargaining power.

Table 4: Ownership of assets and access to institutional factors and production technology among maize farmers in the Highveld

Variable	Participants (n=119)	Non-participants (n=72)	Pooled sample (n=191)	
	%	%	%	Chi-square
Institutional factors				
Accessed credit	74.8	11.1	50.8	72.78***
Membership to farmer group	65.5	25.0	50.3	29.50***
Accessed marketing information	73.1	8.3	48.7	75.34***
Accessed extension services	78.2	26.4	58.6	49.56***
Household assets				
Bicycle	36.1	15.3	28.3	9.62***
Vehicle	48.7	18.1	37.2	18.08***
Donkey/ox cart	43.7	30.6	38.7	3.26*
Mobile phone	88.2	76.4	83.8	4.63**
Working radio	75.6	45.8	64.4	17.37***
Livestock	68.9	44.4	59.7	11.16***
Land	42.3	50.8	47.6	1.32
Production technology				
Hybrid seed	81.5	66.7	75.9	5.41**
Inorganic fertilizer (kg)	88.8	59.7	77.5	20.91***

*** p<0.01,** p<0.05,*p<0.1

Source: Author's compilation.

Assets: Ownership of transport assets, mobile phone, radio, and livestock was significantly different between participants and non-participants (Table 4). Transport assets were skewed towards market participants (36 per cent owned bicycles, 43 per cent carts, and 49 per cent powered vehicles). This implies reduced transport costs. In addition, more than 60 per cent of sellers owned a mobile phone, working radio, and livestock. Livestock for traction may imply that participants cultivated more land, while ownership of a mobile phone and working radio may suggest better access to current farming and price information.

Production technology: The Highveld being the second-largest maize producer in the country, one would expect intensive use of production technology. As shown in Table 4, more than 80 per

cent of participants used hybrid seed and inorganic fertiliser; hence, a significant difference between the two groups. Typically, maize producers incurred low production costs as a result of drought-tolerant and disease-resistant seeds, uniform appearance, and high yields compared with non-participants.

5 Commercial orientation of women maize farmers

5.1 Women's decision to commercialise maize

The Probit was used to distinguish market participants from non-market participants. Therefore, the dependent variable had a binary response (yes=1, no=0) and was specified as follows for both sub-samples:

Pr (MAIZMKT) = f (AGE, EDUC, HHSIZE, FSIZE, LIVEOWN, RADIO, TRANS, COMM, SAV, CREDIT, NFARM, MKTINFO, EXT, FASS, FERT)

Before estimating the selection model, the study examined for possible multicollinearity problems by using the correlation matrix and Variance Inflation Factor (VIF). Both diagnostic tests confirmed that multicollinearity was not a problem in the male and female sub-samples. All variables had a VIF less than the critical value of 5 and the pairwise correlation was less than the standard 0.8 (Gujarati 2007). Table 5 presents the coefficient estimates and the marginal effects of the Probit model for women farmers (see Table A1 in Appendix A for the econometric results for men farmers). The model correctly predicted 84 per cent of the participation outcomes in women farmers. The Wald test of the hypothesis that the coefficients are equal to zero was rejected at the 1 per cent significance level. This further explains the variations in the households' probability to sell maize caused by the explanatory variables included in the model. Of the 15 variables included, 13 had coefficients significantly different from zero.

Household size had a significantly positive effect on market participation. Larger households had a 5 per cent greater probability of participating in the market. Larger households with a more active labour force are more likely to engage in output markets because they have lower production costs, which ensures that they produce surplus produce, thus enabling market orientation. Boughton et al. (2007) found a similar result in their study in Mozambique.

Farm size was significant and had a positive influence on the decision to enter the maize market. An increase in farm size increases production, thereby increasing sales volume. Therefore, an increase in a household's arable land leads to an increase in the probability of a decision for maize commercialization. This suggests that larger farms enable women to surpass their subsistence needs, thereby producing surplus to sell. This result conforms to findings by Zivenge and Karavina (2012), who found land size to have a positive effect on the decision to sell in Zimbabwe.

Table 5: Determinants of maize market participation decisions and level of participation among women farmers

Factor	Probit model		OLS model	
	Coefficient	Marginal effects	Coefficient	Robust Std. Error
Constant	-3.590		-1784.816	1308.899
	(2.390)			
Household characteristics				
Age (years)	-0.162***	-0.00930***	-11.187	13.236
	(0.0467)			
Educational level (dummy)	-3.070***	- 0.176	-1436.059	728.385**
	(1.555)			
Household size (number)	0.798***	0.0457***	30.171	46.365**
	(0.224)			
Household assets				
Farm size (ha)	0.805***	0.0461***	210.504	91.998**
	(0.252)			
Livestock (dummy)	4.007***	0.229***	349.335	236.922
	(1.234)			
Working radio (dummy)	2.333***	0.134***	-273.675	276.281
	(0.843)			
Vehicle (dummy)	0.649	0.0372	-62.720	254.280
	(1.021)			
Mobile phone (dummy)	-4.353***	- 0.249**	1301.699	373.949***
	(1.517)			
Financial endowment				
Off-farm income (dummy)	3.403***	0.195***	445.262	240.622*
	(0.940)			
Savings (dummy)	3.362**	0.193**	-432.937	320.913
	(1.374)			
Credit (dummy)	4.728***	0.271***	90.628	232.018
	(1.421)			
Institutional factors				
Membership in farmers' association (dummy)	3.052***	0.175***	321.604	211.246
	(0.956)			
Extension services (dummy)	0.190	0.0109	622.034	313.792**
	(0.759)			
Marketing information (dummy)	6.887***	0.394***	-418.287	300.378
	(1.500)			
Production technology				
Used fertiliser	4.345***	0.249**	588.922	302.132**
	(0.928)			
Product characteristics				
Price (E)			-2.658	1.054**
Commercialization index			5544.456	976.241***
Lambda (inverse Mills ratio)			-739.278	400.598*
N = 130 % Correctly predicted = 84	CHI-SQ = 36.46***	R-SQ = 65	F-test = 18.50***	

Source: Author's compilation.

Livestock ownership had a significant positive effect on participation. Ownership of livestock increased the likelihood of entering the maize market by 9 per cent for female farmers. This implies the availability of draught power, which can be used to increase crop production, inducing farmers to engage in the maize market. Also, cattle manure may be used as a fertiliser, which may enhance productivity. This finding is consistent with Moono (2015), who found livestock ownership to increase the probability of entering the rice market in Zambia.

The coefficient for working radio had a significant and positive effect on participation. Ownership of a working radio raised the probability of maize market participation by 13 per cent. Access to marketing information gathered through radio programmes reduces risk perceptions and false information gathered from other sources. It ensures increased information flow among farmers in remote areas. This finding corroborates that of Moono (2015). On the other hand, ownership of a mobile phone had a significantly negative effect on participation. Even though mobile phones

are readily available and may be used to transmit market information, they may result in various sources (i.e. neighbours, extension agents, etc.) 'interpreting' that information and transmitting propaganda, which accounts for the 25 per cent reduction in the likelihood of participation.

Belonging to a farmers' group had a significantly positive influence on the decision to enter the market. Membership in social organizations increased female market participation by 18 per cent. Membership in such networks reduces fixed transaction costs by enabling farmers to exchange information as well as linking them with potential buyers. This finding corroborates that of Matungul et al. (2001).

Access to marketing information was positive and significantly influenced the decision to enter the market. Households with access to price and marketing information were 39 per cent more likely to the participate in the market. This result is consistent with Komarek (2010), who found availability of market information to influence the likelihood of entering the banana market in Uganda.

Access to credit also positively influenced the decision to participate in the maize market. Access to loans enables farmers to purchase farm inputs and/or hire farm machinery such as tractors and ploughs. This allows them to plough more arable land, thus encouraging commercialization.

Non-farm income was also positive and statistically significant. This result was expected, since non-farm income equips households with economic power to invest in farm technology and improvements, leading to farmers participating in intensive agriculture. Masuku et al. (2001) found a similar result in their study in Eswatini.

Savings had a significantly positive effect on participation. Access to savings eases liquidity constraints that the farm might be experiencing. This contributes to commercial production. Likewise, access to savings provides farmers with the power to spend in input markets, purchasing agricultural commodities that boost maize yields, leading to marketable surplus. Aidoo et al. (2014) found a similar result in their study.

The coefficient for inorganic fertiliser had a positive and statistically significant impact on market participation. Use of fertiliser contributes to increased yield and consequently increases marketable surplus, thus influencing women farmers' decision to participate in the maize market by 25 per cent.

The coefficient of age was statistically significant and negatively related to market participation. Older women farmers were 0.93 per cent less likely to participate in the maize market. A possible explanation could be the aging labour force in the region. Older farmers are more concerned about food security and more emotionally connected to land and farming (Randela et al. 2008). Therefore, they are less likely to gamble with their grain reserves. This result conforms to the findings by Moono (2015) in Zambia.

Education level had a significantly negative impact on the probability of market participation. This could be because women with a higher education are less likely to participate in the maize market as sellers. They engage in farming on a part-time basis, while most of their energy is directed towards more remunerative employment opportunities. This result is consistent with Ouma et al. (2010), who found education level to negatively influence participation in the banana market in Burundi and Rwanda.

5.2 The level of participation in market by women maize farmers

The second stage of the selectivity model identifies factors influencing the level of maize sales. The model is specified as:

SALES = f (AGE, EDUC, HHSIZE, FSIZE, LIVEOWN, RADIO, TRANS, COMM, SAVACC, CREDIT, NFARM, MKTINFO, EXT, FASS, FERT, HCI, PRICE)

Before running the model, the Breusch-Pagan/Cook-Weisberg test was conducted to test for heteroskedasticity. The results showed violation of the homoscedasticity assumption. To correct for this, robust standard errors were used. The model R-square for female farmers was 65 per cent with a significant overall fit. In addition, the coefficient for the inverse Mill's ratio, λ, was significantly different from zero ($p<0.1$). This indicates that sample selection bias would have resulted if female maize supply equations had been estimated without the consideration of the decision to sell.

Education level negatively influenced the level of commercialization for women farmers. A possible explanation is that education empowers women to participate in the modern sector of the economy, thereby inclining women to full-time jobs and engagement in farming only on a part-time basis. This results in small fields being cultivated, thereby lowering the yield and subsequently the quantity sold. Household size was significant and had a positive effect on women farmers' supply decisions. This implies that larger households result in more produce being transported to the market, thereby increasing the quantity sold.

The coefficient of farm size was positive and significant for marketed supply. A larger farm size enables farmers to plough more. Therefore, larger landholdings allow farmers to produce beyond their household food consumption needs. This suggests that women farmers with larger farms were at an advantage of producing and selling more surplus to the market. This finding corroborates that of Martey et al. (2012), who found the intensity of market participation to increase as the farm size increases.

Inorganic fertiliser had a significantly positive impact on quantity sold. The use of fertiliser may result in higher maize yields, thereby increasing the amount of maize sold in output markets. This finding suggests that it would be advantageous for both producers and consumers to be provided with input subsidies, such as subsidised maize seed and fertiliser, rather than government price support. This is because the former have a positive impact on household incomes as well as ensuring affordable prices for consumers (Muricho et al. 2015).

The coefficient on price was significant and negatively related to the level of maize sales. This could be a result of the low prices charged by the NMC. Such prices discourage farmers from venturing into the maize market, resulting in low quantities sold. Therefore, the impact of maize prices on the quantity sold is in contrast to the objectives of government price support policies, which aim at encouraging farmers to be net sellers of maize, as this can increase household income, thereby improving their standards of living. This study's finding contradicts that of Olwande and Mathenge (2012), who found that lower output prices acted as an incentive for farmers to produce and supply more to markets.

Ownership of a mobile phone had a significantly positive impact on sales. Mobile phones ensure increased connectivity between farmers and traders, thereby making information on markets readily available, and reduce the cost of accessing information. This suggests that women farmers, who had a higher rate of mobile phone ownership, had better access to marketing infrastructure, thereby increasing the level of market participation.

Access to extension services had a significant positive effect on the quantity of maize sold by women. Extension personnel help link farmers with markets, thus increasing market opportunities. This suggests that women farmers with access to such services had a better understanding of new production practices and technology. Siziba et al. (2011) found a similar result in their study in SSA.

Access to off-farm income had a positive and significant influence on sales volume. This implies that households earning higher incomes sold more produce than households earning less income. Women are engaged in various income-generating activities outside the farm. These include running spaza shops, making handicrafts, and brewing beer. These alternative income sources not only contribute to household incomes but also enhance large-scale production by enabling investment in farm inputs and technology. This finding corroborates that of Alene et al. (2008).

The coefficient for the commercialization index had a statistically significant and positive effect on market supply. This result is consistent with a priori expectations, as greater quantity produced generates marketable surplus. It further highlights the importance of increasing output to ensure that women engage in agricultural markets. This will also lead to enhanced rural livelihoods through increased incomes from sales.

6 Conclusion and recommendations

Empirical evidence shows that women farmers are keen to participate in the maize market, as 60.8 per cent of the women in the sample (79 out of 130) engaged in the market as maize sellers. However, women experience daunting constraints when attempting to access the market. This study identified the factors that influence the market participation of women maize farmers. The decision of whether or not to participate in the maize market was influenced by age, education, household and farm size, ownership of livestock, radio and mobile phone ownership, membership in a farmers' group, access to marketing information, use of fertiliser, off-farm income, savings, and access to credit. The level of market participation was influenced by education, household and farm size, mobile phone ownership, off-farm income, price, access to extension services, use of fertiliser, and the commercialization index.

Agricultural development policies need to be geared towards addressing the needs, assets, and constraints of women farmers for them to be effective and efficient. Areas identified by the study as requiring particular attention are:

(i) **Development of financial services** such as banking, which includes village banking and small group loans targeted at women farmers, i.e. low-income entrepreneurs with small farming enterprises, as well as specific agricultural loans to help purchase farm inputs and equipment. Money transfers are another product that could help farmers to send and receive money without incurring additional costs. Crop insurance and savings accounts would assist women farmers during hard times.
(ii) **Revision of land policies** to enable women to *kukhonta* on their own and have land ownership rights, thereby securing tenure, leading to land investment and increased agricultural productivity, as well as the potential to put up land as collateral to secure loans and exploit market opportunities.
(iii) **Development of rural infrastructure** such as constructing and maintaining roads connecting rural areas to market places. The development of retail outlets in communities and districts would ensure reasonable and competitive prices for women's produce. Also, the establishment of community shops to purchase farm inputs is essential.

(iv) **Promoting social capital** such as women's and farmers' groups, associations, and cooperatives to assist in distributing information, spreading TCs, and generating economies of scale.
(v) **Provision of extension services**, which includes educating women farmers on cropping techniques, improved varieties, optimal input use, price-setting, and market conditions. An increase in the number of female field staff would also benefit women farmers.
(vi) **Provision of workshops and training programmes** on efficient methods of production management, soil testing, and the timing and intensity of use of chemical products such as pesticides, herbicides, and fertilisers.

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Appendix A

Table A1: Determinants of maize market participation decisions and level of participation by men farmers

Factor	Probit model		OLS model	
	Coefficient	Marginal effects	Coefficient	Robust Std. Error
Constant	-4.181		-3918.953	1793.494
	(3.848)			
Household characteristics				
Age (years)	-0.0799**	-0.00862**	-19.785	19.583
	(0.0323)			
Educational level (dummy)	2.112	0.228	1152.516	537.995**
	(1.550)			
Household size (number)	0.426***	0.0459***	149.925	112.713
	(0.135)			
Household assets				
Farm size (ha)	0.401	0.0432	870.876	169.294***
	(0.440)			
Livestock (dummy)	-0.826	-0.0891	56.679	339.904
	(1.240)			
Working radio (dummy)	-0.877	-0.0946	14.157	368.533
	(0.684)			
Vehicle (dummy)	1.873	0.202	1014.300	
	(1.590)			
Mobile phone (dummy)	1.102**	0.119**	399.254	354.417
	(0.565)			
Financial endowment				
Off-farm income (dummy)	-0.709	-0.0765	-527.534	478.949
	(1.051)			
Savings (dummy)	0.609	0.0657	532.094	684.111
	(1.503)			
Credit (dummy)	0.696	0.0751	-598.541	547.400
	(0.995)			
Institutional factors				
Farmers' association (dummy)	0.138	0.0149	-61.551	411.981
	(0.780)			
Extension services (dummy)	1.737*	0187*	949.100	479.796**
	(0.927)			
Marketing information (dummy)	1.545	0.167	986.413	484.982**
	(0.980)			
Production technology				
Used fertiliser	1.185**	0.128**	672.463	349.172*
	(0.571)			
Product characteristics				
Price (E)			-0.144	1.517
Commercialization index			1059.914	1388.495
Lambda			572.982	277.197**
N = 61 % Correctly predicted = 70	CHI-SQ = 37.66***	R-SQ = 74	F-test = 7.08***	

Source: Author's compilation.