 J Hum Ecol, 45(3): 207-221 (2014)

Cattle Commercialization in Rural South Africa: Livelihood Drivers and Implications for Livestock Marketing Extension

Jorine T. Ndoro[1*], Maxwell Mudhara[2] and Michael Chimonyo[3]

[1]Department of Agricultural Extension and Rural Resources Management, [2]African Centre for Food Security, [3]Department of Poultry and Animal Sciences, University of KwaZulu-Natal, P/Bag X01 Scottsville, 3209, Pietermaritzburg, South Africa
[*]E-mail: jorinendoro@gmail.com

KEYWORDS Market Participation. Sustainable Livelihood Framework. Double-Hurdle Model. Agricultural Extension. South Africa

ABSTRACT Commercialization of livestock farming systems remains a challenge in rural South Africa. Recent empirical evidence places agricultural extension at the forefront of policy strategy to address this challenge. This study applies the sustainable livelihood framework (SLF) to quantitatively analyze the factors confounding participation in cattle markets for the purpose of informing agriculture extension programming. Based on a dataset compiled from a household survey of 230 randomly selected smallholder cattle farmers in Okhahlamba Local Municipality (OLM), a Double-Hurdle econometric estimation technique is used to determine factors within the SLF influencing market participation and supply volumes decisions. The results reveal that the low rate of market participation could be explained by the broader aspects of livelihoods of smallholder cattle farmers, including limited access to financial, social and natural capital, as well as the difference in livelihood strategies and motivations. Based on these findings, the study draws the implications for the design of livestock extension programs in OLM, and South Africa in general.

INTRODUCTION

Background of the Study

Market participation is an important ingredient for agricultural and rural development. Commercialization of smallholder farming systems through active participation in cattle markets has the potential to exploit developing regions' comparative advantages and transform rural economies (Boughton et al. 2007; Rios et al. 2009; Mathenge et al. 2010). Commercializing smallholder farming systems leads to increased productivity and improved quality of produce, thereby contributing to improved incomes. Hence, market participation by smallholder cattle farmers has the potential to lead to specialized, market-oriented farming systems (Rios et al. 2009).

In South Africa, the recent growth in livestock markets brought about by high population and income growths, urban migration, globalization, and their associated changes in lifestyles and consumer preferences, has presented new opportunities for smallholder livestock farmers to be integrated into the market economy (Delgado et al. 2001; Coetzee et al. 2005; Uzchezuba et al. 2009). Cattle production contributes between 25% and 30% per annum to South Africa's national agricultural GDP (Musemwa et al. 2008). In addition to its importance in the national economy, cattle production is a key livelihood strategy of the resource-poor smallholder farmers in South Africa, where around 40% of the total cattle herd size is owned by communal and emerging farmers (National Department of Agriculture 2011). Cattle production by smallholder farmers constitutes a major livelihood strategy particularly for farming households living in marginal areas with degraded lands, and meager economic opportunities, and hence acute poverty, food insecurity and unemployment (Machethe 2004).

The appeal of cattle as a viable agricultural investment option has influenced rural development policies in South Africa. Several strategic intents have been devised to transform the rural livestock sector towards a commercialised industry. The National Livestock Development Strategy proposes to support smallholder and emerging farmers to be competitive and profitable (National Department of Agriculture 2006). The strategy proposes to support smallholder livestock farmers through creation of an enabling policy environment, investment in rural commercial and cooperative infrastructure, market development, training and research, and equitable

participation, and integration into sustainable rural development (National Department of Agriculture 2006). In addition, for the livestock sector, the agricultural marketing strategy has set out to develop commodity groups/associations for ease of smallholder farmers' access to market information and agricultural marketing infrastructure (National Department of Agriculture 2010). These incentives have opened up a variety of market channels for livestock farmers, including auctions, speculations, abattoirs, butcheries, as well as farm-gate sales (Nkosi and Kirsten 1993).

Despite the congruence of incentive structures and processes, the cattle markets in South Africa remain characterized by low participation rates of smallholder farmers. Recent studies found the levels of cattle commercialization to be directly proportional to the holding, with rates of 33% for herd of 10 or less cattle, 52% for 11-20 cattle owners, and 85% for 20 or more cattle keepers (Coetzee et al. 2005; Lehloenya et al. 2007; Musemwa et al. 2007; Groenewald and Jooste 2012). These studies have documented off-take rates ranging between 5% and 10 % among communal lands/smallholder farmers compared to 25 % for commercial farmers (Musemwa et al. 2010).

As studies in the agricultural economics literature explain, lower levels of smallholder farmers' participation in agricultural markets can be explained by the incidence of costs or/and non-commercial motives. The transaction costs consist of fixed transaction costs arising from imperfect information, such as the search cost for customers with good terms and conditions, negotiations and bargaining, screening, enforcement, and the costs proportional to the level of activity encompassing per unit costs of market access such as transportation and imperfect information (Key et al. 2000). As Barrett (2008) explains, the extent of these costs largely depends on the household's capability, as defined by its endowment including education, physical infrastructure, social networks and access to public goods such as agricultural extension services, roads, information and communication. Also, there is another body of literature contending that in southern African, cattle are kept for wealth storage rather than income generation (Doran et al. 1979). The asset accumulation and ownership benefits such as security and prestige outweigh market incentives (Jarvis 1980).

Agricultural extension is one aspect that should be strengthened to reduce the transaction costs faced by smallholder farmers in the livestock markets (Bahta and Bauer 2007; Uchezubal et al. 2009). This realization is emerging even as agricultural extension approaches are undergoing paradigm shifts, from a top-down, technology transfer model of extension delivery to multifunctional, farmer-centered, participatory and systems–based approaches to rural development (Duvel 2000; Coetzee et al. 2005; Anandajayasekeram et al. 2008; Swanson and Rajalahti 2010). The new approaches are supposed to address the real needs of the farmers and encourage their innovativeness.

Research Problem and Objective

Empirical studies in agricultural marketing in South Africa consider agricultural extension only as a discrete ingredient whose access can offset or moderate high transaction costs and other challenges. Such studies do not explore the varying degrees to which agricultural extension can play an integrative role that fosters agricultural market participation. This leaves a vacuum in the understanding of the relevance of different agricultural extension models and methods in addressing the complexity of farmers' issues related to livestock markets participation.

For a more practical approach to analyzing cattle commercialization and addressing the role of extension in livestock market participation, an application of the sustainable livelihood framework (SLF) has two unique advantages. First, the framework gives an explicit consideration of both aspects of challenges and barriers to market participation, that is, transaction cost and farmers' motivations (Department for International Development 1999). Second, it offers an integrative programming framework for poverty alleviation in a sustainable manner (Krantz 2001). In line with appropriate extension models for South Africa (Duvel 2000), the SLF is a responsive and participatory programming framework that builds on people's strengths, and at the same time attempts to overcome their challenges and barriers at multiple levels, thus ensuring that micro-level challenges inform policy development and macro-level environment enables people to build on their strengths (DFID 1999).

Leveraging on this appeal, the objective of the study is to empirically investigate the ef-

fects of factors under different SLF components on market participation decisions among smallholder cattle farmers, for the purpose of recommending appropriate agricultural extension models and methods.

The remainder of this paper is sub-divided into five sections. The subsequent section overviews the key findings of previous empirical studies in the domain of livestock market participation in South Africa. It is followed by a methodological section outlining the empirical strategy adopted by the study, and a section discussing the empirical findings. The last two sections conclude and draw the implications for agricultural extension in South Africa.

Literature Review

Market participation cannot be explained by a single factor (such as price incentives) since it stands out to be both a consequence and a cause of development (Barrett 2008). Farm households' market participation requires access to technology, private and public (institutional and physical) productive assets, which entails various sunk and fixed costs, coordination problems, and liquidity constraints at all decision-making levels (Barrett 2008). The costs associated with market transactions (customer search, negotiation, bargaining, screening, etc.), in particular, determines difference in market relations among smallholder farmers (Key et al. 2000). These transaction costs, which are largely dependent on household-specific factors, can push smallholder farmers' livelihoods into low-level equilibrium traps of semi-subsistence farming systems (Dorward et al. 2003; Barrett 2008). In this line of analysis, a number of empirical studies in the domain of cattle market participation within South Africa have documented various confounding livelihood factors. This section presents an overview of these findings, with a sustainable livelihoods lens.

On the livelihood vulnerability context, cattle mortality and thefts were found to be significant factors explaining positive livestock market participation decisions in Limpopo, Eastern Cape and Northwest Provinces (Montshwe 2006).

With regard to livelihoods assets, empirical studies have documented the significance of human, physical, financial, and natural capital. With regard to human capital, Makhura (2001) found that female-headed-households are more likely to participate in the Northern Province's livestock market. In the Northern Cape Province, Uchezubal et al. (2009) found that households with few and experienced members have high chances of engaging in livestock markets, whereas shorter distances to market and market infrastructure enhanced participation. The finding that smaller household sizes could explain positive market participation decisions was sharply contrasted by Monthswe (2006) who revealed that, in Limpopo, Eastern Cape and Northwest Provinces, larger households in terms of the number of members are more likely to participate in livestock market. He further found that trained farmers and those who live within shorter distances to market had more probabilities of participating in livestock markets. These results were vindicated by Bahta and Bauer (2007) in the Free State Province. The significance of access to extension services has been commonly evidenced in the literature, including studies such as Uchezubal et al. (2009) and Bahta and Bauer (2007). Access to market information is also constantly revealed as a key market participation factor (Bahta and Bauer 2007).

The endowment in natural resources, particularly the herd sizes, has also been found to influence market participation rates among smallholder livestock farmers (Makhura 2001; Montshwe 2006; Bahta and Bauer 2007). The significance of the influence of financial assets has also been documented. For instance, indebtedness was found to be a significantly negative factor of market participation among small-scale livestock farmers in the Northern Cape (Uchezubal et al. 2009).

On the structures and processes, however, important processes in the livestock industry have been overlooked by empirical studies. Yet, qualitative studies have pointed out that compliance with livestock management regulations (such as the Livestock Identification Act) figures among livestock marketing constraints faced by small-scale farmers in South Africa (Coetzee et al. 2005; Groenewald and Jooste 2012).

The motivational aspect of livestock marketing has also been investigated. Non-commercial motives in the keeping of livestock include economic functions (for example, wealth storage), agro-economic functions (for example, provision of draft power), agro-ecological functions (for example, provision of manure), nutritional (for

example, provision of milk) as well as socio-cultural functions (for example,, dowry) (Nkosi and Kirsten 1999; Lehloenya et al. 2007; Groenewald and Jooste 2012). Makhura (2001) showed that the more unearned incomes (pension) the household receives, the less the probability of its market participation, suggesting the predominance of non-commercial motives. However, these findings were in contrast with the findings of Montshwe (2006) showing that, in the Limpopo, Eastern Cape and Northwest Provinces, household who received unearned incomes had more chances of participating in livestock markets.

Notwithstanding the important insight of these studies, none of them analyse transaction cost and motivational aspect in an integrated manner, which the objective of this study.

METHODOLOGY

Study Area

This study was conducted in Okhahlamba Local Municipality (OLM), a 344,000ha municipality in the UThukela District of the KwaZulu-Natal Province (see Fig. 1). The 2007 population census indicates that the municipality is inhabited by 151,414 people (or 28,508 households), mainly traditional households (56%), illiterate (38%), and communal lands dwellers (OLM 2012). Vast majorities of these people are deprived of public infrastructure (with only 39%, 63%, and 44% having access to electricity, water in their dwellings, and transportation, respectively) (OLM 2012). As reported by the municipality, the harsh economic conditions are such that around 36% of household do not receive any income, whilst 37% earn less than R9,600 (around US$1,100) per annum (OLM 2011).

In this area, commercial and subsistence farming coexist, although geographically separated (a legacy of the segregationist regime of the apartheid era). Smallholder farmers, mainly engaging in maize, vegetable, and livestock production, occupy the marginal areas, mainly the foothills of the Drakensberg mountain range chain, characterized by low-fertility lands (Elleboudt 2012). Although only 22% of the economically active population engages in crop farming (OLM 2012), 55% of households living on communal land engage in livestock farming, mainly consisting of cattle, goats and sheep (Elleboudt 2012). Mixed livestock-crop farming system is a special feature of agriculture in the foothills of Drakensberg region, where grazing is scheduled such that cattle are sent to uphill areas during the cropping season in summer, while all the land becomes grazing land off-season in winter (Elleboudt 2012). This creates overstocking tendencies among locals with the associated environmental consequences, and the situation is reinforced by the lack of property rights and enforcement mechanisms such as fencing. The area is also know to experience harsh climatic conditions, characterized by an interchange of droughts conditions in summer and heavy snow in winter, making the palatability of the natural grasslands very seasonal, and farmers have to provide supplementary feeding (Elleboudt 2012).

Empirical Framework

Following the prescriptions of Bellemare and Barrett (2006) and other previous studies such as Winter-Nelson and Temu (2005) and Alene et al. (2008), this study uses a sample selection model to unpack market participation behavior among smallholder farmers. Hence, to estimate the influence of livelihood factors in explaining participation and supply decisions among cattle farmers, this study adopts the Double-Hurdle (DH) econometric technique, as initially proposed by Cragg (1971).

Under this empirical strategy, a cattle farmer has to cross two hurdles to become a participant in a cattle market. First, the farmer becomes a "potential participant" after crossing the first hurdle, i.e. after making a positive decision to participate in the livestock market. A potential participant, capability factors will determine his actual/observed level of participation in the second hurdle. Therefore, the DH model is a two-equation framework (Matshe and Young 2004; Moffatt 2005; Ground and Koch 2008), as depicted in the equation 1.

Considering I_i^* as a binary choice variable, Q_i^{s*} as a latent variable which reflects the number of cattle sold (therefore the observed variable, Q_i, being determined as $Q_i = I_i^* \cdot Q_i^{s*}$), Z and $\acute{a}$ being the vectors of factor explaining the decision of participation and their influences respectively, and X and $\hat{a}$ being the vector of factors explaining the intensity of participation and their influences respectively; the DH model can be written as follow (Matshe and Young 2004; Moffatt 2005; Ground and Koch 2008):

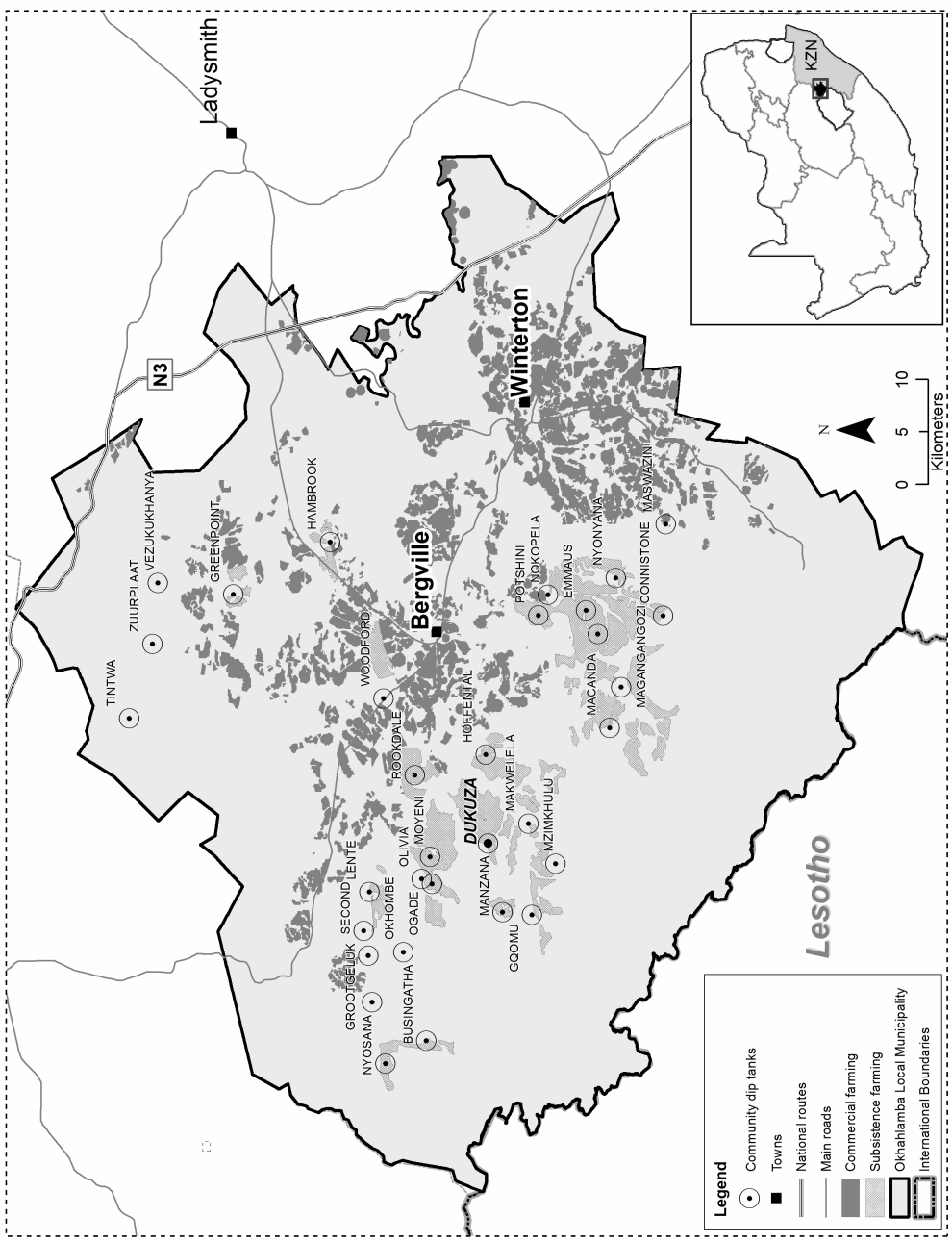

Fig. 1. Land use map of the Okhahlamba Local Municipality showing dip tanks
Source: Authors - based on land cover dataset provided by the Ezemvelo KwaZulu-Natal Wildlife (http://www.bgis.sanbi.org/kzn/landcover.asp).

$$I_i^* = Z_i'\alpha + \varepsilon_i \quad \text{first hurdle} \qquad (1)$$
$$Q_i^{s*} = X_i'\beta + \mu_i \quad \text{second hurdle}$$

$$\begin{pmatrix}\varepsilon_i \\ \mu_i\end{pmatrix} \sim N\left[\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & 0\\0 & \sigma^2\end{pmatrix}\right] \qquad (2)$$

where,

The log-likelihood function for the DH model is:

$$LogL = \sum_0 \ln\left[1-\Phi(Z_i'\alpha)\Phi\left(\frac{X_i'\beta}{\sigma}\right)\right] + \sum_+ \ln\left[\Phi(Z_i'\alpha)\frac{1}{\sigma}\phi\left(\frac{(Y_i - X_i'\beta)}{\sigma}\right)\right] \qquad (3)$$

The analysis of marginal effect helps to assess the impact of the exogenous variables on the dependent variables. To do so, the unconditional mean is decomposed into the effect on the probability of participating and the effect on the conditional level of participation and differentiating these components with respect to each explanatory variable. The unconditional mean can be written as:

$$E[Q \mid X_i] = P(Q_i > 0) \cdot E(Q_i \mid Y_i > 0)$$

The probability of participation and the expected number of cattle sold conditional on participation are:

$$P(Q_i > 0) = \Phi(Z_i'\alpha)\Phi\left(\frac{X_i'\beta}{\sigma}\right) \qquad (4)$$

and

$$E(Q_i \mid Q_i > 0) = \Phi\left(\frac{X_i'\beta}{\sigma_i}\right)^{-1} \int_0^{\infty}\left(\frac{Q_i}{\sigma_i\sqrt{1+\theta^2 Y_i^2}}\phi\left(\frac{T(\theta Q_i) - X_i'\beta}{\sigma_i}\right)\right)dY_i \qquad (5)$$

Sampling and Data Collection

The above-outlined model was fed with household-level data collected in two phases. The first phase, the researchers conducted participatory rural appraisals (PRA) during the period of June to October, 2012. Over the course of this period, key informant interviews with extension personnel were conducted, followed by focus group discussions with knowledgeable members of various dip-tank users associations (DUAs), through their mother cooperative, the Okhahlamba Livestock Cooperative (OLC). This phase was meant to picture key challenges and barriers around cattle marketing in OLM, as perceived by OLC members[1]. The information gathered during this phase was used to device a structured household survey questionnaire that was pilot-tested and administered by trained field enumerators during the second phase, spanning from November, 2012 to February, 2013. Farm households were randomly selected for structured interviews based on a two-stage random sampling technique. In the first stage, 12 out of 31 DUAs were randomly selected using simple random selection technique, that is, with a random number generator. In the second stage, 20 members of each pre-selected DUA were selected randomly based on a systematic random sampling procedure. In total, 230 heads of cattle farm households were interviewed at their homesteads.

The information gathered during the survey was on the various livelihood characteristics of the farm household, based on various components of the SLF, including the vulnerability context, the livelihood assets, structures and processes, livelihoods strategies, and livelihood outcomes. Furthermore, the questionnaire captured key market participation behaviors, as well as farmers' perceptions about market participation challenges and barriers.

Empirical Estimation and Sample Description

To estimate the effect of livelihood factors on the market participation decisions (first hurdle), the Probit regression was used. The intensity of participation levels, the second stage (second hurdle) was estimated using a truncated regression model (Wooldridge 2002). Prospective variables were first shortlisted based on the information gathered during the PRA phase as well as key factors unveiled by previous empirical studies. Thereafter, a prospective variable was selected for the regression based on the significance of its contribution to the improvement of the model's fit that is, the Log-Likelihood ratio (LR) test (Wooldridge 2002). This technique guaranteed that the selected variables would give the best fit.

Multicollinearity was tested using a correlation matrix presented in Table 4 (appendix), the results of which suggest that multicollinearity was not a serious problem in the data. To curb the potential heteroskedasticity in the model, the study used the heteroskedasticity-robust standard errors for parameter estimates.

For the model on the first hurdle, that is, the decision to participate in livestock markets, the self-selection bias was corrected for each participating household by generating the Inverse Mills Ratio (IMR) from the predicted probabilities of the probit model and subsequently including it as an explanatory variable in the truncated regression of level of participation (Wooldridge 2002). Although theory does not point to

the need of imposing exclusion restrictions in the Double-Hurdle model as with the Heckman model, an exclusion restriction was imposed in the model since the IMR variable can be correlated with the vector of explanatory variables in the intensity model especially if both hurdles have equal vectors of explanatory variables (Wooldridge 2002). It is recommended that a variable that is likely to affect the selection but not have partial effect on the intensity model can conveniently be excluded. Potential factors to be excluded in the intensity model were those that explained, to some extent, the fixed transaction costs, since they influenced only the first participation decision model (Key et al. 2000; Alene et al. 2008). Using the LR test, distance to market was excluded.

In consideration of the above-mentioned technicalities, and following the design of the SLF, the sample statistics describing the variables used in the empirical model are presented in Table 1. As the table shows, nearly 48% of interviewed farm households had participated in cattle markets. Vulnerability to climatic conditions was more pronounced among the interviewed households, with staggering proportions of 40-50% and 20-26% reporting cattle loss following severe winters and droughts, respectively. However, the rates were not statistically different between market participants and non-participants groups. With regard to human capital indicators, the majority of interviewed household heads were born in between 1953 and 1955, and household heads in the market participants group were significantly younger than their counterparts. The majority of interviewed farmers (50-65%) had recently benefited from extension training organized by the provincial Department of Agriculture. Households in market participants group, however, had relatively and significantly received more T&Vs than farmers in the non-participants group.

Regarding social capital, the majority of interviewed farmers were members to the Okhahlamba Livestock Cooperative (OLC), although the rate of membership was significantly higher in the market participants group. The rates of participation in farmer-to-farmer extension programs were, however, lower, ranging from 12% in the participants group to 6% in the non-participants group. The difference in the participation rates between groups was however not statistically significant. The rates of participation in the savings groups (stokvels) ranging from 34% (non-participants groups to 42% (participants) were recorded.

For physical capital, about 11% of interviewed households owned a tractor and stayed within 21 km distance to the Dukuza cattle market. With regard to natural capital, the average herd sizes ranged between eight for non-participants, and 14 for participants, and the difference was statistically significant. The walking distance to the nearest source of water was statistically different between the two groups, with the majority of households in the participants group walking 20 min, while their counterparts walk 14 minutes. With regard to the transforming structures and processes, the majority in both groups had tagged their cattle although the participating group recorded a significantly higher tagging rate.

For the livelihood outcomes, incomes from livestock sale were significantly more important in the livelihoods portfolio among interviewed market participant than in the non-participant group, whereas the importance of remittances was significantly more pronounced among households in the non-participants group. The expected cattle price was about R5, 500.

RESULTS AND DISCUSSION

The results of the participation and supply models are presented in Table 2 and Table 3. The variables are presented based on the component of the SLF to facilitate their discussion.

Livelihood Assets

The results of both regressions show that among human and social capital factors, the coefficient of farmer-to-farmer extension variable is significant for the supply model. This finding allows inference that, given positive participation decision, potential participants that received extension trainings and information sharing sessions through their groups tend to supply more cattle to the market. Therefore, this result suggests that farmers do capitalize on the information networks when deciding the amount of cattle to be sold. This finding vindicates the contention that what matters for positive economic outcomes among the poor is not membership in groups, but the quality and quantity of resources (information) flowing within those networks (DFID 1999; Kirsten et al. 2009).

On household's financial capital, participation in saving groups turns out to be a major predictor of the decision to participate as a cattle seller. Other livelihood factors remaining unchanged, opening an account in a local saving group (or a stokvel) significantly increases the probability of participating in cattle market as a seller by 13.4%. Arguably, smallholder farmers that belong to saving groups have access to credit that enables them to increase the productivity and market value of their herd, thereby increasing the prospect of market participation.

On natural capital, the regression results indicate that cattle market participation and supply decisions are significantly and positively governed by the cattle herd size. Adding one cattle to the herd significantly increases the chances of participating in cattle market as a seller by 1.8%, *ceteris paribus*. These findings vindicate the hypothesis that agricultural market participation is associated with its productivity (Lapar et al. 2003; Rios et al. 2009) and the empirical evidence that shifting to commercial cattle farming systems in Southern Africa requires growth in herd sizes (Behnke 1987).

The results of the Probit model also show that the cattle breed has a significant effect on market participation decisions. All other factors in the model remaining constant, shifting from an exclusively indigenous breed (Nguni) herd to mixed/crossbred herds, towards exotic breed significantly reduces the farmer's prospect of cattle market participation, implying that farmers who keep indigenous breed are more likely to participate in market as sellers. This suggests that farmers do take into account the breed when deciding to sell their cattle. This is probably due to the fact that the indigenous breed of the eastern and northern South Africa is more fertile, matures earlier, is well adapted to low quality feed, and therefore easily replaceable compared to other breeds (Bayer et al. 2004). This finding suggests that both the quantity and quality of cattle herd are important for a pro-poor market development strategy.

Lastly, the coefficient of walking distance to the nearest water source also has a significant positive effect, and it can be inferred that OLM cattle farmers staying far from water sources such as rivers and dams have more chances of participating in cattle market as sellers. This finding signals the potential of distress sales among smallholder farmers, particularly during adverse periods of prolonged drought (Elledoubt 2012).

Transforming Structures and Processes

The empirical results of the participation model yield a positive and significant coefficient for cattle tagging. These results suggest that compliance with the Livestock Identification Act is a key factor in cattle marketing, and perhaps the most important constraint to the cattle market participation in the empirical model. *Ceteris paribus*, registering (branding and marking) the cattle herd increase market participation propensity by 21%. This finding vindicates the assertions of Coetzee et al. (2005) and Groenewald and Jooste (2012) that livestock registration legislation is an important factor for a pro-poor cattle market development policy in South Africa.

Livelihood Strategies

The results of the participation model show that the coefficient of the rank of cattle income, among other income generation strategies, is negative and significant. This result means that households whose primary income earner is cattle farming are more likely to participate in cattle market, suggesting that the portfolio of livelihood strategies explains the differences in cattle market participation rates among smallholder farmers. This implies that the degree of specialization in cattle farming is an important predictor of cattle market development.

Livelihood Outcomes

The results in Table 2 show that the coefficient of the rank of remittances in the income portfolio is significantly positive, suggesting that cattle farmers who regularly secure more unearned incomes such as remittances from their family members and friends are not likely to participate in cattle market. This result is in line with the walking-bank hypothesis of livestock marketing (Bellemare and Barrett 2006), suggesting that market participation decisions are driven by the need to cater for immediate household needs when cash is not otherwise available.

The results also show that the coefficient of the expected price variable is only significant in the supply model. Consistent with the findings of previous studies done in developing countries such as the study by Alene et al. (2008), this empirical finding reveals that smallholder farmers do not necessarily consider information on prevailing price incentive when deciding to

Table 1: Description of variables and t-test of equality of means for independent variables used in the empirical model

Variable category, SLF component, and variable name	*Variable description*	*Measurement*	*Value labels*	*Participants N=113*	*Non- participants N=117*	*p-value*
Dependent variables						
MARKPART	Decision to participate in cattle market during the last three years	Dummy	1 = the household has participated in cattle market as a seller, and 0 = otherwise.			
TOTSOLD	Number of cattle sold over the period of the last three years	Count				
Independent variables						
1. Vulnerability context						
SNOWLOSS	Experience with cattle deaths resulting from heavy snow over the last three years	Dummy	1= the household experience cattle death attributable to heavy snow over the last three years; 0= otherwise.	.49	.41	.246
DROUGHTLOSS	Experience with cattle deaths resulting from prolonged period of droughts over the last three years	Dummy	1= the household experience cattle death attributable to drought conditions over the last three years; 0= otherwise.	.20	.26	.273
Asset pentagon						
Human capital						
BIRTHDAYHHH	Year of birth of the head of household	Continuous		1955.94	1953.08	.076
GOVEXTVISIT	Access to extension training and visit from government extension agents over the last three years	Dummy	1= the farmer received a government extension training or visit over the last three years; 0=otherwise.	.6460	.5043	.030
Social capital						
OLCMEMB	Membership in OLC	Dummy	1= the head of household is a member of OLC; 0= otherwise.	.84	.74	.071
F2FEXT	Access to farmer-to-farmer extension trainings over the last three years	Dummy	1= the farmer received farmer-to-farmer extension training or information sessions over the last three years; 0=otherwise.	.1239	.0684	.154
Financial capital						
SAVGROUP	If the household is a member of a stokvel	Dummy	1= The head of households ave money in a stokvel; 0= otherwise.	.42	.34	.198

Table 1: Contd...

Variable category, SLF component, and variable name	*Variable description*	*Measurement*	*Value labels*	*Participants N=113*	*Non- participants N=117*	*p-value*
Physical capital						
TRACTOR	Ownership of tractor–an indicator of fixed cattle production cost	Dummy	1=The head of household owns a tractor; 0=otherwise.	.10	.11	.734
RDDISTTODUKUZA	Shortest driving distance (Km) from the community's dip tank to Dukuza cattle market place (measured using GPS navigation software) – an indicator of fixed cattle transaction cost	Continuous		21.5770	20.2650	.461
Natural capital						
HERDSIZE	Total number of cattle owned at the time of interview – – an indicator of managed ecosystem goods and services	Count		14.68	8.92	.000
CATTLEBREED	Type of breed owned by the farmer – an indicator of managed ecosystem goods and services	Categorical – Ordinal	1= Nguni; 2= Mixed; 3= Exotic breed	1.73	1.77	.578
WATERSOURCEDIST	Walking distance (in minutes) between the household and the nearest cattle water source – an indicator of access to natural ecosystem services.	Continuous		21.61	14.74	.097
Transforming Processes and structures						
CATTLETAG	Cattle are tagged - an indicator of compliance with Livestock Identification Act	Dummy	1=Cattle conforms to the required identification tags, 0= otherwise.	.95	.85	.020
Livelihood strategies						
CATTLEINCRANK	The importance (rank) of incomes from cattle sales among regular sources of earned income	Categorical	1 = most important ~ 5= least important	3.89	2.86	.000
Livelihood outcomes						
REMITRANK	The importance (rank) of remittances among regular sources of unearned income	Categorical	1 = most important ~ 5= least important	2.65	3.44	.000
EXPPRICE	Expected cattle price at farm gate and from speculators in the community	Continuous		5480.7670	5595.0095	.339
Inverse mills ratio (IMR)	The standard normal probability distribution function over the standard normal cumulative distribution function of the predicted probabilities	Continuous				

Source: Authors' survey, 2012-2013

sell their cattle. Nonetheless, the evidence suggests that given positive participation decisions, smallholders will consider price signals when deciding upon the number of cattle to be sold on the market. These results possibly suggest that market participation and volume decisions are not taken simultaneously, that is, although predisposed to selling their cattle, livestock farmers do not pre-commit the number of cattle to be sold before learning information about the prevailing market conditions, especially the price. However, the negative sign indicates that there is a considerable scope of non-commercial motivations such as wealth storage, and cattle is only sold when a farm household faces pressing cash needs (Doran et al. 1979; Groenewald and Jooste 2012). The results validate the finding that farmers who manage to secure more incomes from alternative sources are less likely to participate in cattle market.

CONCLUSION

This study falls within the realm of participatory agricultural extension approaches. Its purpose is to investigate the livelihood drivers of smallholder cattle farmers' participation and supply decisions in OLM within a framework of informing the design of livestock extension architecture in South Africa. The goal is to explain the low rates of cattle market participation by smallholder farmers in the region and suggest appropriate extension models for extension programming in the context of OLM. Based on a household survey dataset compiled from a survey of 230 randomly selected cattle farm households, the study runs a Double-Hurdle econometric model to calibrate the effect of factors under various components of the SLF on the participation and supply decisions.

The empirical results of this study reveal that the low rate of market participation cannot be simply explained by endowments and access factors (the determinants of transaction cost), but the broader aspects of livelihoods of smallholder cattle farmers in South Africa. Notably, this study finds that the difference in access to finance, natural capital endowments, and livelihood strategies could explain the rate of market

Table 2: Livelihood determinants of farmers' decisions to participate in cattle market in OLM, Results estimated using Probit regression model

SLF component and variable name *Dependent variable: MARKPART*	*Coefficient*	*Marginal effects*	*p>|Z|*
1. Vulnerability Context			
SNOWLOSS	-.127	-.051	0.527
DROUGHTLOSS	-.355	-.140	0.124
Asset pentagon			
Human Capital			
BIRTHDAYHHH	.009	.003	0.247
GOVEXTVISIT	.277	.110	0.186
Social Capital			
OLCMEMB	.177	.070	0.472
F2FEXT	.444	.173	0.165
Financial Capital			
SAVGROUP	.338	.134	0.078
Physical Capital			
TRACTOR	-.277	-.109	0.367
RDDISTTODUKUZA	.002	.001	0.729
Natural Capital			
HERDSIZE	.046	.018	0.000
CATTLEBREED	-.458	-.182	0.031
WATERSOURCEDIST	.009	.003	0.002
Transforming Processes and Structures			
CATTLETAG	.565	.216	0.070
Livelihood Strategies			
CATTLEINCRANK	-.187	-.074	0.003
Livelihood Outcomes			
REMITRANK	.189	.075	0.001
EXPPRICE	-.000	-.000	0.280
Constant	-18.088	-	0.241
Number of obs	= 227		
Wald chi2(16)	= 64.92		
Prob > chi2	= 0.000		

Source: Authors' survey, 2012-2013.

participation. It also provides evidence of a motivational aspect in cattle marketing in South Africa. To a certain extent, the results reveal that cattle market participation in OLM is essentially a reactive livelihood strategy, a fallback plan against harsh environmental and/or economic conditions.

IMPLICATIONS FOR LIVESTOCK EXTENSION

This sample evidence on the effect of various livelihood factors on cattle market participation has considerable implications for the design of livestock extension programs in OLM, and South Africa, in general.

Table 3: Livelihood determinants of cattle market supply volumes among smallholder farmers in OLM, Results estimated using truncated regression model

SLF component and variable name	*Coefficient*	*p>|Z|*
Dependent variable: TOTSOLD		
1. Vulnerability Context		
SNOWLOSS	2.872	0.728
DROUGHTLOSS	-11.825	0.318
Asset Pentagon		
Human Capital		
BIRTHDAYHHH	-.135	0.619
GOVEXTVISIT	.922	0.915
Social Capital		
OLCMEMB	-11.722	0.197
F2FEXT	21.966	0.029
Financial Capital		
SAVGROUP	-3.275	0.631
Physical Capital		
TRACTOR	7.991	0.287
RDDISTTODUKUZA		
Natural Capital		
HERDSIZE	1.340	0.002
CATTLEBREED	7.648	0.481
WATERSOURCEDIST	.052	0.648
Transforming Processes and Structures		
CATTLETAG	-14.332	0.235
Livelihood Strategies		
CATTLEINCRANK	5.213	0.225
Livelihood Outcome		
REMITRANK	3.147	0.298
EXPPRICE	-.005	0.092
IMR	14.140	0.349
Constant	148.752	0.774
Number of obs	=111	
Wald chi2(17)	=28.09	
Prob > chi2	=0.030	

Source: Authors' survey, 2012-2013.

Table 4: Correlation matrix for independent variables used in the econometric model

	SNOW LOSS	DROUGH TLOSS	BIRTH DAYHHH	GOVEX TVISIT	OLCM EMB	F2 FEXT	SAVG ROUP	TRA CTOR	RDD ISTTO DUKUZA	HERD SIZE	CATTLE BREED	WATER SOURC EDIST	CATTL ETAG	CATT LEINC	REMM IRATE	EXPP RICE
SNOWLOSS	1															
DROUGHTLOSS	0.1452	1														
BIRTHDAYHHH	0.0241	0.0796	1													
GOVEXTVISIT	0.1205	0.0594	-0.0370	1												
OLCMEMB	0.1163	-0.0147	0.0221	0.2555	1											
F2FEXT	0.0663	0.1317	0.0903	-0.1717	-0.1221	1										
SAVGROUP	0.0418	0.0065	0.0303	0.0696	-0.0800	0.0480	1									
TRACTOR	0.0669	0.0434	0.0267	0.0913	-0.0325	-0.0158	-0.0058	1								
RDDISTTODUKUZA	-0.0850	-0.1961	0.1165	0.0147	0.0715	-0.0810	0.0331	-0.0281	1							
HERDSIZE	0.2181	-0.0110	0.2058	0.1714	0.0034	0.0208	-0.0798	0.1048	-0.0403	1						
CATTLEBREED	0.0443	-0.0753	-0.0583	0.2056	0.0216	-0.1726	0.1313	0.1221	-0.0158	0.0845	1					
WATERSOURCEDIST	0.0111	0.0598	-0.0814	0.2038	0.0987	-0.1051	-0.0111	0.0153	-0.1732	0.0771	0.1657	1				
CATTLETAG	0.0362	0.1190	0.0276	-0.0510	0.0406	0.1100	0.0545	-0.0745	-0.0042	0.1230	0.0687	-0.0812	1			
CATTLEINCRANK	0.1565	0.0368	0.0271	0.0360	0.1321	0.1435	0.0525	0.0670	-0.0896	0.1739	0.0839	-0.0773	0.1528	1		
REMITRANK	-0.0091	0.1165	-0.0196	-0.0799	-0.1016	0.0022	0.0473	-0.0646	-0.2057	-0.1394	-0.0122	0.0618	-0.0691	-0.1680	1	
EXPPRICE	-0.0273	0.0202	0.0150	-0.0494	-0.0362	0.0799	-0.0168	0.0141	-0.2121	-0.0048	0.0779	0.0896	-0.0254	0.0440	0.0001	1

The significantly positive effect of farmer-to-farmer extension on cattle market supply suggests that farmer extension groups are key players in the livestock market development. Public livestock extension systems designed in such a way to support cattle farmers' group formation and involvement, not just as "contact groups" that transmit messages from public extension staff, but as active players of extension service function (Anandajayasekeram et al. 2008; Swanson and Rajalahti 2010) are therefore expected to spur smallholder cattle farmer's ability to participate in rural markets. This objective can be achieved through creation of an open, democratic and supporting environment through which these groups can thrive, supporting capacity building to improve their management, injecting basic resources to improve their internal functioning, and extending their links with other group (DFID 1999). This result supports the imminent role of a pluralistic extension environment for a pro-poor cattle market development strategy.

This latter strategy has even further appeal. Given the significantly positive effect of access to saving groups for cattle marketing in the region, the livestock extension programs that extend cattle farmers' access to financial institutions are expected to scale up market participation among smallholders in South Africa. This can be achieved by encouraging individual cattle farmers and their organizations to save money, with programs for tailoring inclusive financial products and for overcoming barriers related to lack of collateral, for example, by identifying mechanisms that enable farmers' natural capital to act as collateral (DFID 1999).

The finding that endowment in natural capital matters for market participation implies that continued efforts by agricultural extension to uplift the productivity of local breeds through access to quality feeds and veterinary services are expected to increase both cattle productivity and market participation in OLM. These efforts can be channeled through a centralized commodity-specialized approach using commodity extension models to ensure access to required inputs including technology and finance as well as financial gains, although farmers' feedback can be better accounted for by other approaches (Anandajayasekeram et al. 2008). However, this productivity emphasis does not need to detract attention from complexity of the issues surrounding the management of natural ecosystems such as water and land for livestock-based livelihoods development in the area. This complexity requires participatory and system approaches to agricultural extension such as the farming system development approach built on a broader understanding of livelihood systems, the combination with other assets to sustain livelihoods, the role of structures and processes that govern the use of these resources (environmental laws, land and water allocation systems).

The significant effect of compliance with Livestock Identification Act implies that public extension strategy focusing on programs that aims to alleviate this challenge can be expected to unlock markets for stallholders. These challenges, as outlined in Coetzee et al. (2005) and Groenewald and Jooste (2012), include high cost of registering unique brands and marking and branding equipments, high possibility of filing claims after stray animals cause road accident or intrude neighboring fields, and lack of branding and marking facilities. Notably, direct support during the identification process such as penetrating villages with branding and marking facilities or subsidizing the branding cost can be envisaged (Groenewald and Jooste 2012). Equally appropriate is an indirect support through structures that represent smallholder cattle farmers to expand their scope to include fast tracking the identification process both in terms of accessibility of facilities and cost reduction for smallholder farmers and access to appropriate forums for decisions making (DFID 1999).

On the significant effect of livelihood strategies, the public livestock extension service system that take into account the diversity of livelihood strategies when designing their programs can have a significant positive effect on market participation. FEGs models can be best developed around households that depend more on incomes from cattle sales, and those that have less sources of unearned incomes (remittances and pensions), if market participation is to be developed. Once again, these results support the need for a participatory extension program to gauge the extent to which different cattle farming systems rely on cattle incomes.

Finally, the results that price incentives drive cattle market supply volumes auger well with a positive expectation from the public extension framework that advocates for a good functioning of institutions that facilitate positive market outcomes by reducing the associated transac-

tion risks and costs in order to sustain better returns to cattle farming and increase its attractiveness. Validating the need for FEGs as previously outlined, the provision of cattle market information to potential participants through farmers' social capital is an important strategy to integrate them into lucrative market chains and high value channels. Using the mass media extension method to disseminate market information also remains an appropriate option. However, as Coetzee et al. (2005) cautions, the format of the information needs to be well understandable by the target farmers (for example, farmers cannot clearly estimate the total value of their cattle based on information on beef price per kilogram live weight).

NOTE

[1] For example, it is during this phase that the researchers were informed about the extent to which cattle prices fetched by smallholders varies considerably across communities, which triggered the need to test the factors motivating cattle marketing in OLM.

REFERENCES

Alene AD, Manyong VM, Omanya G, Mignouna HD, Bokanga M, Odhiambo G 2008. Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy,* 33: 318–328.

Anandajayasekeram A, Puskur R, Workneh S, Hoekstra D 2008. *Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book*. Nairobi: International Livestock Research Institute.

Bahta ST, Bauer S 2007. *Analysis of the Determinants of Market Participation within the South African Small-scale Livestock Sector: Utilisation of Diversity in Land Use Systems: Sustainable and Organic Approaches to Meet Human Needs*. Tropentag, October 9-11, 2007, Witzenhausen.

Barrett CB 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy,* 33: 299–317.

Bayer W, Alcock R, Gillies P 2004. Going Backwards?-Moving Forward?-Nguni Cattle in Communal KwaZulu-Natal. Rural Poverty Reduction Through Research for Development and Transformation. *A Scientific Paper Presented at a Conference held at Agriculture and Horticultural Faculty,* Humboldt-Universitat zu, Berlin.

Behnke RHJ 1987. Cattle accumulation and the commercialization of the traditional livestock industry in Botswana. *Agricultural Systems,* 24(1): 1–29.

Bellemare F, Barrett CB 1993. An ordered Tobit model of market participation: Evidence from Kenya and Ethiopia. *American Journal of Agricultural Economics,* 88(2): 324-337.

Bollinger A 2007. *Is Zero-Till an Appropriate Agricultural Alternative for Disadvantaged Smallholders of South Africa? A Study of Surrogate Systems and Strategies, Smallholder Sensitivities and Soil Glycoproteins*. PhD Thesis, Unpublished. Copenhagen: University of Copenhagen.

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

Carter MR, Lybbert TJ 2012. Consumption versus asset smoothing: Testing the implications of poverty trap theory in Burkina Faso. *Journal of Development Economics,* 99: 255–264.

Coetzee L, Montshwe BD, Jooste A 2005. The marketing of livestock on communal lands in the Eastern Cape Province: Constraints, challenges and implications for the extension services. *South African Journal of Agricultural Extension,* 34: 81-103.

Cragg JG 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica,* 39(5): 829-844.

Delgado CL, Rosegrant MW, Meijer S 2001. Livestock to 2020: The Revolution Continues. *Paper presented at the Annual Meeting of the International Agricultural Trade Research Consortium (IATRC),* Auckland, New Zealand, January 18-19, 2001.

Department for International Development (DFID) 1999. *Sustainable Livelihoods Guidance Sheets - Framework*. London: DFID.

Doran MH, Low ARC, Kemp RL 1979. Cattle as a store of wealth in Swaziland: Implications for livestock development and overgrazing in eastern and southern Africa. *American Journal of Agricultural Economics,* 61: 41-47.

Duvel GG 2000. Towards an appropriate extension approach for agriculture and rural development in South Africa. *South African Journal of Agricultural Extension,* 29: 10-23.

Elledoubt R 2012. *Are Conservation Agriculture Practices an Interesting Option for the Smallholder Farmer Communities of the Okhahlamba Local Municipality, KwaZulu-Natal, South Africa?* Masters Thesis, Unpublished. Gent: Universiteit Gent.

Groenewald JA, Jooste A 2012. Smallholders and livestock. In: HD van Schalkwyk, JA Groenewald, GCG Fraser, A Obi, A van Tilburg (Eds.): *Unlocking Markets: Lessons from South Africa*. Mansholt Publication Series - Volume 10. Wageningen: Wageningen Academic Publishers, pp. 113-131.

Ground M, Koch S 2008. Hurdle models of alcohol and tobacco expenditure in South African households. *South African Journal of Economics,* 76(1): 132-143.

Jarvis LS 1980. Cattle as a store of wealth in Swaziland: Comment. *American Journal of Agricultural Economics,* 62(3): 606–613.

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

Kirsten JF, Doward AR, Poulton C, Vink N (Eds.) 2009. *Institutional Economics Perspectives on African Agricultural Development*. Washington: International Food Policy Research Institution.

Krantz L 2001. *The Sustainable Livelihood Approach to Poverty Reduction: An Introduction*. Stockholm: SIDA.

Laper ML, Holloway G, Ehui S 2003. Policy options promoting market participation among smallholder livestock producers: A case study from the Philippines. *Food Policy,* 28: 187-211.

Lehloenya KC, Greyling JPC, Schwalbach LMJ 2007. Small-scale livestock farmers in the peri-urban areas of Bloemfontein, South Africa. *South African Journal of Agricultural Extension,* 36: 217-228.

Low ARC, Kemp RL, Doran MH 1980. Cattle wealth and cash needs in Swaziland: Price response and rural development implications. *Journal of Agricultural Economics,* 31: 225-236.

Makhura MT 2001. *Overcoming Transaction Costs Barriers to Market Participation of Smallholder Farmers in the Northern Province of South Africa*. PhD Thesis. Pretoria: University of Pretoria.

Mathenge M, Place F, Olwande J, Mithoefer D 2010. Participation in Agricultural Markets among the Poor and Marginalized: Analysis of Factors Influencing Participation and Impacts on Income and Poverty in Kenya. *Study Report*. Tegemeo Institute, Egerton University.

Matshe G, Young T 2004. Off-farm labour allocation decisions in small-scale rural households in Zimbabwe. *Agricultural Economics,* 30: 175-186.

Moffatt PG 2005. Hurdle models of loan default. *The Journal of the Operational Research Society,* 56(9): 1063-1071.

Montshwe BD 2006. *Factors Affecting Participation in Mainstream Cattle Markets by Small-scale Cattle Farmers*. MSc Thesis. Bloemfontein: University of Free State.

Musemwa L, Chagwiza C, Sikuku W, Fraser G, Chimonyo M, Mzileni N 2007. Analysis of cattle marketing channels used by small scale farmers in the Eastern Cape Province, South Africa. *Livestock Research for Rural Development,* 19(9): Article 3.

Musemwa L, Mushunje A, Chimonyo M, Mapiya C 2010. Low cattle market off-take rates in communal production systems of South Africa: Causes and mitigation strategies. *Journal of Sustainable Development in Africa,* 12(5): 209-226.

Musemwa L, Mushunje A, Chimonyo M, Fraser G, Mapiye C, Muchenje V 2008. Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. *African Journal of Agricultural Research,* 3(4): 39-245.

National Department of Agriculture (NDA) 2006. *Livestock Development Strategy for South Africa*. Department of Agriculture, Forestry and Fisheries, Republic of South Africa.

National Department of Agriculture (NDA) 2010. *Agricultural Marketing Strategy for the Republic of South Africa*. Department of Agriculture, Forestry and Fisheries, Republic of South Africa.

National Department of Agriculture (NDA) 2011. *A Profile of the South African Beef Market Value Chain.* Department of Agriculture, Forestry and Fisheries, Republic of South Africa.

Nkosi SA, Kirsten JF 1999. The marketing of livestock in South Africa's developing areas: A case study of the role of speculators, auctioneers, butcheries and private buyers in Lebowa. *Agrekon,* 32(4): 230-237.

Okhahlamba Local Municipality (OLM) 2011. *Okhahlamba Local Municipality Draft IDP Review-2011/2012*. Okhahlamba Local Municipality.

Okhahlamba Local Municipality (OLM) 2012. *Final Integrated Plan 2012-2017*. Okhahlamba Local Municipality.

Rios AR, Shively GE, Masters WA 2009. Farm Productivity and Household Market Participation: Evidence from LSMS Data. *Contributed Paper Prepared for Presentation at the International Association of Agricultural Economists Conference,* Beijing, China, August 16-22, 2009.

Swanson BE, Rajalahti R 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming and Evaluating Extension Systems. Agricultural and Rural Development *Discussion Paper 45*.Washington: The World Bank.

Uchezuba1 UI, Moshabele E, Digopo D 2009. Logistical estimation of the probability of mainstream market participation among small-scale livestock farmers: A case study of the Northern Cape province. *Agrekon,* 48(2): 171-183.

Winter-Nelson A, Temu A 2005. Impacts of prices and transactions costs on input usage in a liberalizing economy: Evidence from Tanzanian coffee growers. *Agricultural Economics,* 33: 243–253.

Wooldridge JM 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.