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ANLYSIS OF THE DETERMINANTS OF MARKET PARTICIPATION WITHIN THE SOUTH AFRICAN SMALL-SCALE LIVESTOCK SECTOR

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Abstract

The livestock sector plays a crucial role in the household food security and poverty alleviation of many developing countries by producing protein-rich food supplies, generating income and employment. It is identified, in the Integrated Sustainable Rural Development Strategy, as a most likely agricultural enterprise to improve the livelihood of small scale livestock farmers in South Africa. However, not much has changed as far as livestock marketing is concerned. This situation requires an in depth investigation.

The main interest of the study is to investigate the major factors which determine livestock farmers' decision to participate in the market. . A binary logistic regression is applied on primary data that was collected from 124 households in all five districts of Free State province, namely Motheo, Lejweleputswa, Thabo mofutsanyana, Xhariep and Northern Free State. Distance to market, market information, births, extentention visit and training were identified as both logical and statistically significant determinants of farmers' decision to sell their livestock. This entails that policy interventions in direction of these factors need to get priority attention by stakeholders, especially as far as the formulation of institutional innovations are concerned.

Moreover, the outcome of this paper lies in that it presents quantitative guidelines on what issue to focus on when addressing apparent institutional constraints that are currently inhibiting the ability of small-scale livestock farmers to access livestock markets in South Africa.

Key words: Livestock, market participation, South Africa

1. INTRODUCTION

Increased incomes, urbanisation and population growth is expected to lead in increasing demand of animal products in the developing world, which can in turn improve incomes of poor farmers and food processors. It is expected, that the demand for animal products will increase by about 50 percent from 19993 to 2020 and mostly attributed to developing countries (Delgado, 1999). In sub-Saharan Africa (SSA) total consumption of meat and milk is expected to double between 1997 and 2020 to reach 11.3 and 35.4 million tonnes (Simon et al. 2002). This expected increase in demand for animal products has profound implications for food security and poverty alleviation among rural people in SSA. In particular, the expected demand for livestock products presents expanding market opportunities for poor smallholder livestock producers. Therefore, improving access to markets of

poor smallholder livestock producers can help them benefit from the rapidly growing demand for livestock products.

In the case South Africa, even though the Integrated Sustainable Rural Development Strategy of the South African Government identifies livestock farming, as the agricultural enterprise with the most likely of improving household food security and addressing poverty alleviation in the small-scale communal farming areas of South Africa, not much has changed since 1994 (NDA, 2005). Very few small-scale farmers participate actively in agricultural markets (Makhura, 2001

In the context of this study, several researchers, among which Van Rooyen, Vink and Christodoulou, (1987), have called for the need for reforms if participation of small-scale farmers in the commercial agricultural markets is to be enhanced and others among which Jooste (1996), noted that the cattle herd in the hands of small-scale farmers is under utilized. Several reasons for this state of affairs have been identified.

The livestock sector can play a more prominent role in alleviating poverty in rural areas of South Africa, where poverty is extremely prevalent. About 50% of the population is considered to live under the poverty line (CIA fact, 2006). However, the sector is faced by great challenges including low economic returns due to a lack of access to markets, lack of access to market information, low levels of tacit knowledge pertaining to the marketing of livestock, slow technology adoption and inferior infrastructure in rural areas (NDA,2005).

This paper provides an empirical basis for analysing the factors that influence the ability of small-scale farmers to more actively participate in the livestock markets in South Africa. The empirical study is based on data from 124 household surveys conducted between 2006 and 2007 in all five districts of the Free State province, namely Motheo, Lejweleputswa, Thabo mofutsanyana, Xhariep and Northern Free State. The main interest of this study is the market participation i.e. the probability of a positive event occurring. In section 2 the data and the methodology used in this study is discussed. The results of the analysis are discussed in section 3. In section 4 conclusions are made and recommendations given.

2 DATA SOURCE AND ANALYTICAL APPROACH

This study uses primary data collected in all five districts of the Free State province, namely Motheo, Lejweleputswa, Thabo Mofutsanyana, Xhariep and Northern Free State. One hundred twenty four sample households who own livestock (cattle, sheep, goats and pigs) are considered for this study.

The logistic regression technique was used to analyse the data collected. According to Wuensch (online), Logistic regression, which is very powerful, convenient and flexible, is used to predict a categorical (usually dichotomous) variable from a set of predictor variables. It is often chosen if the predictor variables are a mix of continuous and categorical variables and/or if they are not normally distributed. With a categorical dependent variable, discriminant function analysis is usually employed if all of the predictors are continuous and normally distributed and logit analysis is usually employed if all of the predictors are categorical.

In this study binary logistic model is employed both for the above mentioned advantage and its comparable simplicity. By using the logistic regression the probability of a result being in one of two response groups (binary response) is modelled as a function of the level of one or more explanatory variables. Thus, the probability whether or not the farmer sells livestock (Cattle, Sheep, Goats, and

Pigs) may be modelled as a function of the level of one or more independent variables. For this study, the response variable is "1" when the farmer sold livestock in the past twelve months and "0" when the farmer did not sell. The functional form is denoted in equation (1).

$$\ln\left(\frac{\phi i}{1-\phi i}\right) = \beta_0 + \sum_{j=1}^{K} \beta j X ij + \varepsilon i \qquad \textbf{(1)}$$

Where: j is the response category (1 or 0), i denotes cases (1, 2, 3, 4…, n), ϕ is the conditional probability, β_o is the coefficient of the constant term, β_j is the coefficient of the independent variable, X_{ij} is the matrix of observed values, ε_i is the matrix of unobserved random effects, $\frac{\phi i}{1-\phi i}$ is "odd", and $\ln\left(\frac{\phi i}{1-\phi i}\right)$ is the logarithm of "odds".

Equation (1) can be manipulated to give the odds ratio using equation (2):

$$\frac{\phi_i}{1-\phi_i} = \exp\left(\beta o + \sum_{i=1}^{k} \beta i Xi\right) \qquad \textbf{(2)}$$

The probability that farm households sell livestock can be calculated using equation (3):

$$\phi_i = \frac{Exp\left(\beta_o + \sum_{i+1}^{k} \beta_j \mathrm{X} i_j\right)}{1 + Exp\left(\beta o + \sum_{i=1}^{k2} \beta j \mathrm{X} ij\right)} \qquad \textbf{(3)}$$

Equation (3) is intrinsically linear since the logit is linear in Xi (Gujarati, 1988); it indicates that probability ϕi lies between zero and one and vary non-linearly with Xi. The equation for calculating partial effects[1] of continuous variable is denoted by:

$$\frac{\partial \phi_i}{\partial x_i} = \phi i\left(1-\phi\right)\beta j \qquad \textbf{(4)}$$

The partial effects of the discrete variables will be calculated by taking the difference of the mean probabilities estimated for the respective discrete variable, $X_i = 0$ and $X_i = 1$.

3. RESULTS OF THE LOGISTIC REGRESSION MODEL

3.1 Characteristics of the Logistic Regression Model

The result shows that, among the thirteen covariates (age, household size, education, ownership of vehicle, land tenure arrangement, Farming system, off farm income, group membership, distance to preferred market channel, number of birth occurred, extension visits, market information and training) considered for the model, participation in livestock market is influence to a great extent by the last five (distance to preferred market channel, number of birth occurred, extension visits, market information and training) covariates. Consequently, the other eight covariates were eliminated from the equation through the iterative backward variable selection process. As it is shown in table 1, all

[1] Once the conditional probabilities are calculated for each sample household, the partial effects of the continuous individual variables can be calculated.

the variables are significant with signs as expected. The value of coefficients or β_j indicates the change[2] in the predicted logged odds associated with a unit change in independent variables (equation 1).

As a measure of goodness of fit the Model Chi-Square was used and there should be no statistically significant difference between observed and predicted values if the model is a good one (Field, 2005). The Model Chi-Square statistic, which is the difference of the values of the two log likelihood functions (i.e. the null model -2 Log Likelihood and the full model -2 Log Likelihood), is 95.565. If the P-value for the overall model fit statistic is less than the conventional 0.05 then there is evidence that at least one of the independent variables contributes to the prediction of the outcome. The latter is true for the fitted model, i.e. the overall model fit statistic is less 0.05 and highly significant at (P<0.001) with twelve degrees of freedom, indicating that at least one of the parameters in the equation is nonzero. With regard to the predictive efficacy of the model, out of 124 sample households included in the model, 111 are predicted correctly. Out of the 124 observed households, 38 per cent do not sell and 62 per cent sell their livestock.

It should be noticed that the interpretation of logit coefficients differ from typical linear regressions (Field, 2005), and hence requires more manipulation in order to calculate the impact of the independent variables on the probability to sell livestock. This is explained in the next section.

Table 1: Results of the logistic regression

Factors	**Coefficients**	**T-values**	**P-values**
Constant	-2.64 (1.57)	-1.6809	0.092774*
Location			
Distance to Market	-1.00 (0.53)	-1.68713	0.061926*
Herd structure			
Births	0.38 (0.13)	2.8443	0.004450***
Institutional aspect			
Market info	3.73 (0.82)	4.5524	0.000005***
Training of farmers			
Trainfar	1.33 (0.70)	1.9018	0.057200*
Extension services			
Extvisits	0.06 (0.03)	1.8876	0.059079*
Model summary			
% Correctly classified			89%
Model chi-square			95.565
Model significance			p< 0.001
N sellers			77
N Non sellers			47

- *** P<0.01, ** P<0.05, * P<0.10
- Values in brackets are standard errors

[2] Increase when $\beta_j > 0$, decrease when $\beta_j < 0$

3.2 Partial effects on conditional probabilities to sell Livestock

The partial effects of the statistically significant variables on conditional probabilities can be used to determine the effect of changes in the respective variables on the probability to sell livestock. Besides, the partial effects calculated from the logistic model show the effect of a change in an individual variable on the probability to sell livestock when all other exogenous variables are held constant. Table 2 shows partial effects of the continuous variables.

Table 2: Partial effects for the significant continuous variables

Determinants	Partial effects
Distance to the preferred channel	-0.02488
Births	0.032346
Extension visits	0.011005

- **Distance to the preferred marketing channel**

It is found that (table 2) distance to the preferred marketing channel is negatively and significantly related to the probability of selling livestock. Hence, the partial effect of a unit increase in distance on the conditional probability of selling livestock is -0.02488. This means that with each unit increase (1km) in distance the probability to sell will reduce by 0.02488. Thus, this finding suggests that households which are closer to market outlets are more likely to sell their livestock than those households living further away. It is interesting to mention that commercial farmers' that are the same distances from markets do sell their livestock on a regular basis. Thus, this issue requires further investigation by incorporating the differences in transaction costs to sell livestock over long distances.

- **Births**

A natural increase of the herd, births, is found to have positive and significant relationship with the probability to sell livestock, i.e. the probability to sell livestock increases with the number of births or a natural increase of herd. The partial effect of a unit increase in the number of birth occurred on the conditional probability of selling livestock is 0.032346. Thus, a unit increase in births will increase the probability to sell livestock by 0.032346.

- **Extension visits**

The partial effects of a unit increase in extension visits on the conditional probability to sell livestock are 0.011005. This means that an additional visit by an extension officer will increase the probability that the farmer will sell his/her livestock by 0.011005.

Table 3 shows the partial effects of the categorical variables, i.e. the change in the probability to sell livestock when $X_i = 0$ and $X_i = 1$.

Table 3: Change in probabilities when Xi = 0 and Xi = 1

Determinants	Probabilities	Change in probabilities
Market information (%)		
Non-receivers	0.371429	0.573015
Receivers	0.944444	
Training (%)		
Not trained	0.431818	0.293182
Well trained	0.725000	

- **Market information**

  The partial effect of market information found from the analysis clearly explains the current state of affairs in the rural areas (with in black communities) of South Africa in general and the Free State province in particular where many farmers don't have information on prices and markets at large. Hence, it is not uncommon to see farmers sell their livestock during funerals. From table 3, keeping the all other variables in the model constant, market information is positively and significantly related to the probability to sell livestock, i.e. receivers of market information are likely to sell more livestock than non-receivers. The findings show that a unit increase in receiving market information defined by the change from non receivers (X_i=0) to receivers (X_i=1) increases the probability of selling livestock from ϕi = 0.371429 to ϕi = 0.944444.

- **Training**

  The findings also show that the probability to sell livestock increase with the level of training received. A unit change in the level of training increase the probability to sell livestock by 0.293182, i.e. when comparing farmers who did not receive training (X=0) to those who are well trained (X=1) show that the probability to sell livestock will increase from ϕi = 0.431818 to ϕi = 0.725000.

3.3 Simulating the impact of changes in the variables on livestock sales

In this section the impact of changes in selected variables on the probability to sell livestock is measured against a base group of households. The base group is considered representative of the non-selling households in the households surveyed and was selected by setting dummy variables at zero and the continuous variables at the mean value. The base group has the following characteristics:

- They don't have market information;
- The average distance from the market is 42 kilometres;
- The average birth rate of 7.6;
- They only receive 7.5 extension visits annually;
- They do not have any training.

Table 4 shows the results of the simulation. The conditional probability to sell livestock for the base group is 0.365647. This can be interpreted as 37 out of hundred households will sell livestock given the abovementioned characteristics.

Table 4: Simulated impact of variables on the probability to sell livestock

VARIABLES	PREDICTED PROBABILITY
Base	0.365647
Distance (mean for the actual)	0.850824
Births increase by 10%	0.844571
Extension visits increase by 1	0.809142
Market information	0.945345

The rest of the results in Table 4 can be summarized as follows:

- A reduction in the average distance to preferred markets by 10 per cent will increase the probability to sell livestock from 0.365647 to 0.850824 out of a hundred households.
- A 10 per cent increase in the current average birth rate will increase the probability to sell livestock from 0.365647 to 0.844571 out of a hundred households.

- An increase in the average number of extension visits by one will increase the probability to sell livestock from 0.365647 to 0.809142.
- Increased access to market information will increase the probability to sell livestock from 0.365647 to 0.945345 out of a hundred households.

The results show that an improvement in the initial conditions will significantly increase the probability of small-scale livestock farmers to sell their livestock. By addressing these initial conditions, i.e. improving them, one can conclude that it will have a significant positive impact on the livelihoods of this group of farmers. After all, the livestock sector was identified by the government as the most likely enterprise in improving the livelihood of rural communities of South Africa. However, this state of affairs will require innovative thought by the different role players in the industry to ensure feasible and actionable plans to enhance the current level of market access by small-scale livestock producers.

4. CONCLUSION

The paper examined the factors affecting livestock market participation. Although this sector has been identified by government, in the Integrated Sustainable Rural Development Strategy, as a most likely agricultural enterprise to improve the livelihood of small scale livestock farmers not much has changed since 1994. Factors that prove to have a significant impact on the ability of small-scale livestock farmers' decision to participate in market are: (i) market information, (ii) distance to the preferred marketing channel, (iii) the level of training (iv) extension visits, (v) births.

Market information in the livestock industry remains one of the big challenges. For example, according to the BATAT marketing report of the department of agriculture, most of the registered livestock agents that can disseminate information are not keen to operate with in the underdeveloped areas, where most of the small scale sector lives, due to: poor road networks, high crime rates and low volume and poor quality of the animals. The findings clearly explains the current state of affairs in the rural areas (with in black communities) of South Africa in general and the Free State province in particular where many farmers don't have information on prices and markets at large. Hence, it is not uncommon to see farmers sell their livestock during funerals. Imagining that the information needs of small-scale livestock farmers are known, one can safely assume that a user-pay information system will overcome the problem of information access. Thus, from a development point of view this state of affairs clearly needs strong government intervention. Not only does it require setting up an information gathering and analysis system, but a strong emphasis will have to be put on ways to disseminate such information to ensure optimal access.

The above mentioned takes us or it is closely inter related with the issue of training. One can not merely assume that small-scale livestock farmers will be able to effectively use the market information they get. Hence, any training programme should incorporate how market information can be used to improve marketing decisions. Training, however, goes beyond the issue of marketing, and issues related to production techniques need to be addressed urgently. Educational institutes can play a great role to improve the level of training of small-scale farmers.

In addition, there is a need to link small-scale livestock producers to existing initiatives, such as breeding programmes which promote increased productivity. It is apparent that extension can play, and should play, a significant role in improving the ability of small-scale livestock farmers to access markets. The role of extension officers, among others, can be: Approaching local community leaders

and the private sector to assist with transport problems and to hire a truck to reduce the unit transport cost, try to make information available. According to NDA (2005) there is a considerable amount of information available but it is very difficult for small-scale farmers to access this and Facilitate in reducing transaction costs by assisting farmers to get organized as a group and establish strategic partnerships with service providers, training institutions, markets, input suppliers and media. Failing to actively pursue such initiatives will prove to be detrimental for the sector both in the medium and long run.

Finally, the aforementioned need to be underpinned by a relevant and efficient institutional system. As mentioned in the beginning, it is not the intention of this paper to come up with precise actions, but rather attempted to quantify relevant factors that affect the ability of small-scale livestock farmers to market their livestock products. Consequently, the contribution of this paper lies in that it provides quantitative guidelines on what issues to focus on when addressing apparent institutional constraints that are currently inhibiting the ability of small-scale livestock farmers to access livestock markets.

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