SOCIOECONOMIC FACTORS INFLUENCING LIVESTOCK PRODUCTION AMONG SMALLHOLDER FARMERS IN THE FREE STATE PROVINCE OF SOUTH AFRICA

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ABSTRACT

The study was conducted across the four district municipalities in the Free State province of South Africa. The objective of the study was to determine socioeconomic factors that affected livestock numbers among smallholder cattle and sheep farmers in the Free State province of South Africa. The research was qualitative and quantitative in nature. Proportionate random sampling method was used to collect data. Data between the 2008 and 2012 farming seasons were collected by administering well-structured questionnaires to 250 smallholder cattle and sheep farmers and analysed with descriptive and inferential statistics. Descriptive statistics results indicated that lack of camp systems, drought prevalence, increased feed costs, poor veterinary interventions, insufficient breeding stock, high cost of fuel and transportation, lack of equipment, diseases, stock theft and pilfering, and insufficient grazing land were the prevalent factors that affected cattle and sheep farming in the province. The OLS regression results indicated that the variables that significantly affected livestock numbers were district, household size, livestock numbers in 2008, planted pastures, grazing land condition, grazing land acquisition, service, advice/training, veterinary services, purchase of dosing products and sales per year. The results also indicated that the majority (96.8%) of the smallholder cattle and sheep farmers would like to increase their livestock numbers. It was therefore recommended that extension and veterinary services should be strengthened in the study area. In addition, it was recommended that smallholder livestock farmers should be encouraged to plant pastures to reduce pressure on the natural veld and make forage available throughout the year. Lastly, as a recommendation, government should provide subsidies with distribution policies that will ensure that all smallholder livestock farmers can benefit.

Keywords: Cattle and Sheep, Enterprise, Ordinary Least Square, Socioeconomic.

INTRODUCTION

Livestock is globally one of the mainstays of the agricultural communities. It provides 50 percent of the value of agricultural output globally and one-third of the value in developing countries (Nouman et al., 2014). Livestock farming makes a distinct contribution to the social and economic development of the rural masses. In many African countries as well as in South Africa, many rural households earn a living from livestock farming and consider keeping livestock as a store of wealth (Mandleni and Anim, 2012). Several factors contributed both positively and negatively to changes in livestock numbers. Some of these factors are economic

growth and increased incomes (Steinfeld et al., 2006),increase in demand for livestock products arising from rapid growth in human population and urbanization (Delgado et al., 1999; Thornton, 2010), developments in breeding, nutrition and animal health (Thornton, 2010), rapid technology innovations (Nouman et al., 2014; Rae, 2008), changing food preferences (FAO, 2009), changes in climatic conditions (Mandleni, 2011) and genetic improvements (Adkinson and Adkinson, 2013).

Mwangi (2013) added that socio-economic and environmental factors such as population growth, urbanization and economic development, changing livestock market demands, impacts of climate variability and science and technology trends contributed to the changes in livestock numbers. According to Ilea (2009), global livestock production is expected to double by 2050, growing faster than any other agricultural sub-sector. Livestock farming has great potential to alleviate household food insecurity and poverty especially in the communal areas of the world, including South Africa (Musemwa et al., 2008). According to Smith et al. (2013), livestock production is an indispensable part of the solution to global food security, and a reasonable amount of the world's food supply comes from systems of which livestock are an important part. Considering the importance of livestock systems for food security, and their potential to impact on poverty, livelihood, health and nutrition as well as the environment, the livestock sector still receives limited attention in the global agriculture and food debate.

Smallholder livestock systems play a very important role in supporting rural livelihoods. In smallholder systems, livestock fulfil many functions in addition to producing meat, milk and eggs. Functions include provision of fertilizer, fuel, draught power and transport; a means of savings and investment; a buffer against crop failure; and diverse cultural and religious roles (FAO, 2009). In sub-Saharan Africa and South Asia, smallholder livestock farmers contribute more than 80 percent of the global livestock production, using foods that are not palatable to humans (i.e. grass, fodder and waste) for their livestock production (Smith et al., 2013). Therefore, this study aimed at investigating the socio-economic factors that affected livestock numbers. The overall intention of the study is to examine how smallholder livestock farmers in the Free State can reduce their vulnerability to factors affecting the livestock farming.

Market Prices of Livestock and their Fluctuations Trends from Year 2006-2016

The beef industry is the second fastest growing commodity in agricultural sector following the broiler sector (Department of Agriculture, Forestry and Fisheries (DAFF, 2017)). This is driven by income growth and supported technological and structural change. In South Africa, stock farming remains the only viable agricultural activity in a large part of the country. Approximately 80% of South African agricultural land is suitable for extensive grazing. Areas for grazing declined owing to expanding human settlements and other activities such as mining, crops, forestry and conservation. 80% of the total cattle heads are for beef cattle and the remaining 20% is for dairy cattle. The South African primary beef production is unique due to its dualistic nature of agricultural sector. The gross value of cattle and calves slaughtered in South Africa from 2006/07 to 2015/16 is depicted in figure 1 below. The gross value of beef production is dependent on the number of cattle slaughtered and the prices received by producers from buyers. The gross value of beef production increased from Rp.13 billion in 2006/07 to Rp.30.6 billion in 2015/16. This is an increase of 135% during the said period. This is due to the increased consumption of beef during this past decade. The average gross value of beef produced during this period amounted to Rp.19 billion per annum (DAFF, 2017) (Figure 1).

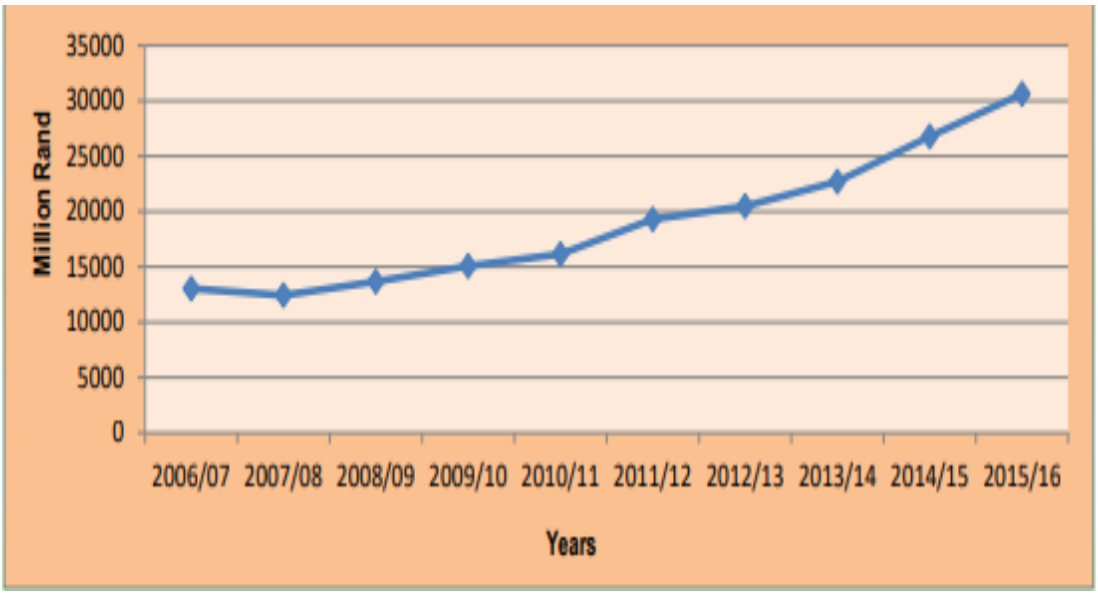

FIGURE 1
Source: Statistic and Economic Analysis (DAFF), 2017.

METHODOLOGY

The study was conducted on four district municipalities of the Free State province in South Africa. Prior to the interviews, a complete list of all smallholder cattle and sheep farmers with at least 30 herds was requested from the Department of Agriculture in all the four district municipalities of the province. These farmers formed the groups that were interviewed using questionnaire as a research tool. A total of 250 smallholder cattle and sheep farmers were selected from 21 towns with a reasonable number of smallholder cattle and sheep across the 19 local municipalities in the four (4) district municipalities of the Free State province of South Africa, using the Proportionate Stratified Random Sampling technique. The selected towns were then divided into four sub-groups, with towns under each of the four district municipalities representing a sub-group. The sample size of each sub-group was proportionate to the population size of the sub-group when viewed against the entire population of smallholder cattle and sheep farmers in the province This means that each of the four district municipalities had the same sampling fraction, and the selected towns in local municipalities under each of the four district municipalities represented a sub-group. Proportionate samples were chosen from each sub-group to complete the questionnaire.

Econometric Model

An Ordinary Least Square (OLS) multiple regression model was used to determine the socio-economic factors that affected livestock numbers in the Free State. This is a mathematical modelling approach that can be used to describe the relationship between a continuous dependent variable and several independent variables (Maree, 2012). Ordinary least square multiple regression is one of the major techniques used to analyse data, and it forms the basis of many other techniques (Rutherford, 2001). Ordinary least square multiple regressions is particularly powerful as it is relatively easy to check model assumptions such as linearity, constant, variance

and the effect of outliers (Hutcheson and Sofroniou, 1999). The OLS regression model with multiple explanatory variables used is of the form:

…….....(1)

Where, Υ represents the continuous dependent variable and it is expressed as a function of variables represented as $\chi_1, \ldots\chi_{21}$. The corresponding parameters β_0 is the intercept, $\beta_{1,\ldots}$ $\beta_{21,}$ represent the changes that occur in y with respect to $\chi_1, \ldots \chi_{21}$.

RESULTS AND DISCUSSION

Socio Economic Characteristics of Respondents

Table 1
SOCIOECONOMIC CHARACTERISTICS OF RESPONDENTS

District Municipality	Variable Frequency	Percentage
Fezile Dabi	35	14
Lejweleputswa	41	16.4
Thabo Mofutsanyana	109	43.6
Xhariep	65	26
Household Size		
0-5	191	76
06-Oct	55	22
>10	4	1.6
Gender		
Male	219	87.6
Female	31	12.4
Age (Years)		
<37	12	4.8
38-57	127	50.8
>58	111	44.4
Marital Status		
Single	16	6.4
Married	202	80.8
Divorced	5	2
Widowed	27	10.8
Level of Education		
Pre-school	2	0.8
Standard 1	39	15.6
Standard 6	76	30.4
Standard 10	68	13.6
Higher	34	12.4

None	31	12
Years of Experience		
01-Jun	35	14
07-Dec	118	47.2
>12	97	38.8
Household Income (Rands)		
60 000	204	81.6
60 000-120 000	36	14.14
120 001-180,000	3	1.2
180 001-240 000	6	2.4
240 001-300 000	1	0.4
>300 000	0	0
Farm Ownership		
Individual company	30	12
Family members	30	12
Farmers' group	84	33.6
Cooperative	7	2.8
Private	13	5.2
Trust	71	28.4
Traditional heads	15	6
Major Occupation		
Farming	193	77.2
Employed	32	12.8
Business	25	10
Total 250	250	100
Source: Field Survey.		

Table 1 displays the demographic characteristics of the respondents. It can be deduced from the table that the majority population of the respondents comprised of adult smallholder cattle and sheep farmers between the age of 38 and 57, with educational level of up to standard six. Most of the farmers (77.2%) practiced farming on a full time basis, indicating that they would have adequate time to supervise their farms and farming activities. Only 12 percent of the farms were owned by individual farmers while most of the farms were owned in groups or by a Trust. Other farms were owned by family members, cooperatives, private companies and traditional heads. This implied that farmers did not have complete control over their farms. According to table, only 14 percent of the farmers are located in Fezile Dabi district municipality of the province. A small percentage (16.4%) was located in Lejweleputswa district municipality. A larger percentage of the farmers were located in Thabo Mofutsanyana district municipality whereas only 26% were located in Xhariep district municipality. This indicated that the majority of the smallholder cattle and sheep farmers were located in Thabo Mofutsanyana district municipality of the Free State province.

As reflected in the table, majority (76%) of the respondents had up to five occupants per household, 22 percent of them had between six and ten occupants per household. Only about 1.6 percent of the respondents had more than ten occupants per household. This showed that some of the household members were likely to provide family labour for farm activities. Successful herd management for maximum profit requires family labour from certain members of household (Majekodunmi, 2011; Omotoso et al., 2018; Daud et al 2018). The results in Table 1 also indicate that majority (87.6%) of the respondents were male farmers while only 12.4 percent were female farmers. The implication was that smallholder cattle and sheep farming were more popular among male than females. Females are still expected to cook and perform house chore duties while males are expected to do jobs that require lots of energy such as certain farm operations involved in herd management (Moyo, 2010).

The table also indicates that larger percentages (80.8%) of the respondents were married while the remaining 19.2 percent were single, divorced or widowed. This implied that most of the farmers were stable in their places of residence and had access to more family labour. As reflected in Table 1, lower percentage of the respondents had between 1 and six years of experience in cattle and sheep farming. The majority (47.2%) of the respondents had between seven and twelve years of experience while about 38.8 percent had more than 12 years of experience in cattle and sheep farming. The implication is that majority of the respondents had substantial years of experience in cattle and sheep farming. Although Table 4 reflects that years of experience of the respondents had a positive effect on livestock numbers, it did not significantly affect livestock numbers.

Prevalent Factors That Affected Smallholder Cattle and Sheep Farming

Table 2 presents factors that affected smallholder cattle and sheep numbers in the Free State. Of the 250 smallholder cattle and sheep farmers interviewed about whether or not they encountered any problems with the camp system, 77.2 percent indicated that they indeed encountered problems and only 22.8 percent indicated that they did not encounter any problems. Of the 77.2 percent of the farmers who encountered problems with the camp system, 8.8 percent encountered problems with water circulation on the camps and 12.0 percent encountered problems with dilapidated fences. At least 7.6 percent indicated an insufficient number of camps, 5.6 percent encountered problems with inadequate water points on the camps, and the majority (43.2%) ranked the problem of having no camps at all on the grazing land as the most prevalent factor with reference to the camp system.

The climate change-related factors were grouped into four categories, namely flood, drought, increased temperature (heat stress) and decreased temperature. At least 2.0 percent of the 250 smallholder cattle and sheep farmers interviewed indicated flood as the most prevalent factor. Most of the farmers (about 96.4 percent) ranked drought as the most prevalent factor. Only 1.6 percent indicated increased temperature (heat stress) as the most prevalent factor. No farmer indicated decreased temperature as a prevalent factor in the study area. The feed-related factors that affected smallholder cattle and sheep numbers were grouped into five categories this is in line with the finding of (Omotayo, 2018). Of the 250 small holder cattle and sheep farmers interviewed, 12.8 percent indicated poor forage quality as the most prevalent feed-related factor. At least 33.2 percent indicated increased feed cost as the most prevalent factor; 27.2 percent indicated feed shortage as the most prevalent factor; 22.0 percent indicated poor or no access to grazing land as the most prevalent factor; and only 4.8 percent did not encounter a feeding-related problem.

Of the 250 smallholder cattle and sheep farmers interviewed, 11.6 percent indicated lack of practical knowledge as the most prevalent factor under the service, advice/training-related factor. Poor veterinary services were ranked by 37.2 percent of the respondents as the most prevalent factor; 18.4 percent indicated poor or no access to credit as the most prevalent factors; 4.8 percent of the farmers indicated little or no extension services as the most prevalent factor; 15.2 percent indicated skills development as the most prevalent factor and only 12.8 percent of the farmers interviewed indicated no prevalent factors related to service, advice/training. In the category for reproduction-related factors, of the 250 smallholder cattle and sheep farmers interviewed 26.4 percent ranked insufficient breeding stock as the most prevalent factor; 15.2 percent indicated premature death as the prevalent factor; at least 18.4 percent indicated poor breeds as the most prevalent factor; and 11.6 percent indicated low birth weight as the most prevalent factor. Only 28.4 percent indicated that no prevalent reproduction-related factor affected their farming.

Of the 250 smallholder cattle and sheep farmers interviewed across the province, 45.2 percent ranked the high cost of fuel and transportation as the most prevalent marketing-related factor. Poor market price was indicated by 33.2 percent as the most prevalent factor under this category. At least 11.2 percent indicated market competition as the most prevalent factor, and only 10.4 percent did not observe any market related prevalent factor. Concerning management-related factors, at least 48.4 percent of the 250 smallholder cattle and sheep farmers interviewed ranked lack of equipment as the most prevalent factor. Lack of equipment was indicated by 5.6 percent as the most prevalent factor, whereas 39.2 percent indicated grazing land management as the most prevalent factor. Only 6.8 percent did not observe any management-related prevalent factor. The animal health-related factor was grouped into five categories. Of the total number of smallholder cattle and sheep farmers interviewed, 25.6 percent indicated pest and parasites as the most prevalent factor.

The majority, 32.0 percent, ranked diseases as the most prevalent factor, and about 4.0 percent indicated vaccines and inoculation as the most prevalent factor. At least 30.8 percent indicated purchase of dosing products as the most prevalent animal health-related factor. Concerning animal loss-related factor, 53.2 percent of the 250 farmers interviewed (the majority) ranked stock theft and pilfering as the most prevalent factor. High mortality was indicated by 27.2 percent of the farmers as the most related factor and only 19.6 percent indicated that no prevalent factor related to animal loss. Factors that affected livestock grazing were also considered as a factor affecting cattle and sheep faming. Of the 250 smallholder cattle and sheep farmers interviewed, 21.6 percent indicated small grazing land as the most prevalent factor; 3.6 percent indicated weed encroachment as the most influencing factor; and 8.0 percent indicated water supply and water-related factors as the most prevalent factor. At least 10.8 percent indicated veld fires as the most prevalent factor and 5.2 percent and 15.2 percent indicated overstocking and overgrazing respectively as the most prevalent factor. Both water supply and weed encroachment were indicated by 2.4 percent of the farmers as the most prevalent factor, 23.2 percent ranked insufficient grass on grazing land as the most prevalent factor and only 10.0 percent indicated no prevalent factor.

When the 250 smallholder cattle and sheep farmers interviewed were asked to describe the condition of the grazing land, the majority (64.0 %) described it as very poor; 13.2 percent described the condition as poor; and 12.0 percent described the condition as fair, with a reasonable number of grass species. Of the farmers interviewed, 8.4 percent described the condition as good with plenty of grass species and only 2.4 percent described the condition as

very good and improving. Furthermore, 8.8 percent of the 250 farmers interviewed indicated that they could acquire additional grazing land very easily; at least 2.0 percent of the farmers indicated acquiring additional grazing land as easy; 20.8 percent indicated that acquiring additional grazing land was difficult; the majority, 66.0 percent, indicated it as very difficult and 2.4 percent indicated they did not know because they had never tried to acquire additional grazing land.

Despite the factors influencing smallholder cattle and sheep farming, 96.8 percent of the 250 farmers interviewed indicated an interest in increasing their stock and only 3.2 percent did not indicate any interest in increasing their stock due to high stock theft. Of the 96.8 percent who indicated their interest in increasing the stock, 43.2 percent would like to do so by acquiring more land. The majority, 47.6 percent, indicated they would increase stock by getting both good breeding stock and more land, and 4.0 percent would only increase the stock by getting good breeding stock. Of the farmers interviewed, 2.0 percent wanted to fence and divide their grazing land into camps in order to increase their livestock numbers. The majority of the farmers (96.8%) interviewed indicated their desire to increase the stock that they kept. However, it can be concluded that lack of camp systems, drought prevalence, increased feed costs, poor veterinary interventions, insufficient breeding stock, the high cost of fuel and transportation, lack of equipment, disease, stock theft and pilfering, and lack of suitable grazing land (which made acquiring additional grazing land very difficult) were the most prevalent factors that affected smallholder cattle and sheep farming in the Free State province.

Table 2
PREVALENT FACTORS THAT AFFECTED SMALLHOLDER CATTLE AND SHEEP FARMING

Variable	Percentage	Mean	S.D	Variance
Influencing factors				
Problem with the current camp system?		1.23	0.42	0.177
Yes=1	77.2			
No=2	22.8			
Factors affecting camp system		4.31	1.615	2.608
Water circulation=1	8.8			
Bad and old fence=2	12			
Insufficient number of camps=3	7.6			
Inadequate water points=4	5.6			
No camp system=5	43.2			
No prevalent factor=6	22.8			
Climate change related factor		2	0.19	0.036
Flood=1	2			
Drought=2	96.4			
Increased temperature (heat stress)=3	1.6			
Feeding related factor		1.089	0.221	1.187
Poor forage quality=1	12.8			
Increased feed cost=2	33.2			
Feed shortage=3	27.2			

Poor or no access to grazing land=4	22			
No prevalent factor=5	4.8			
Service, Advice/Training related factor		3.13	1.624	2.637
Practical knowledge=1	11.6			
Poor veterinary interventions=2	37.2			
Poor or no access to credit=3	18.4			
Little or no extension services=4	4.8			
Skills development=5	15.2			
No prevalent factor=6	12.8			
Reproduction related factor		3	1.572	2.47
Insufficient breeding stock=1	26.4			
Premature death=2	15.2			
Poor breeds=3	18.4			
Low birth weight=4	11.6			
No prevalent factor=5	28.4			
Marketing related factor		1.87	0.983	0.966
High cost of fuel/transportation=1	45.2			
Poor market price=2	33.2			
Market competition=3	11.2			
No prevalent factor=4	10.4			
Management related factor		2.04	1.073	1.151
Lack of equipment=1	48.4			
Maintenance=2	5.6			
Grazing land management=3	39.2			
No prevalent factor=4	6.8			
Animal health related factor		2.63	1.351	1.825
Pest/parasite=1	25.6			
Disease=2	32			
Vaccines/inoculation=3	4			
Purchase of dosing products=4	30.8			
No prevalent factor=5	7.6			
Animal health related factor		2.63	1.351	1.825
Pest/parasite=1	25.6			
Disease=2	32			
Vaccines/inoculation=3	4			
Purchase of dosing products =4	30.8			
No prevalent factor=5	7.6			
Animal loss related factor		1.66	0.786	0.618
Stock theft/pilfering	53.2			
High mortality	27.2			
No prevalent factor	19.6			

Factors that affects the grazing of animals		5.41	3.265	10.661
Small grazing land=1	21.6			
Weed encroachment=2	3.6			
Water supply & related factors=3	8			
Veld fire=4	10.8			
Over stocking=5	5.2			
Over grazing=6	7			
Water and weed encroachment=7	23.2			
Insufficient amount of grass=8	10			
No prevalent factor=9	15.2			
Present condition of grazing land		1.72	1.113	1.239
Very poor with little grasses=1	64			
Poor with some grasses=2	13.2			
Fair with reasonable grasses=3	12			
Good with plenty grasses=4	8.4			
Very good & improving=5	2.4			
Land acquisition		3.51	0.932	0.869
Easily=1	8.8			
Very easily=2	2			
Difficult=3	20.8			
Very difficult=4	66			
Don't know=5	2.4			
Would you like to increase your stock		1.03	0.176	0.031
Yes=1	96.8			
No=2	3.2			
How do you intend to increase stock		1.74	0.882	0.778
Getting bigger land=1	43.2			
Getting good breeding stock				
Getting bigger land and=2	47.6			
Good breeding stock=3	4			
Fencing and dividing grazing				
land into camps=4	2			
Not increasing stock=5	3.2			

Descriptive Statistics of Livestock Numbers In 2008 And 2012

Variables of descriptive statistics are presented in Table 3. The tables provide information about the cattle and sheep numbers between 2008 and 2012 as the same group of farmers were interviewed to collect information about the socio-economic factors that affected smallholder cattle and sheep farming in years 2008 and 2012. From Table 1 cattle and sheep numbers from less than 100 to more than 400 between years 2008 and 2012 were not stable. Households with cattle and sheep numbers that were less than 100 during the period of study had

a decline in cattle and sheep numbers by 11 percent. Yet households with cattle and sheep numbers between 100 and 200 experienced an increase by 6.8 percent, and those with cattle and sheep numbers between 201 and 300 experienced an increase by 1.6 percent. Again households with cattle and sheep numbers that were between 300 and 400 experienced a decline by 0.40 percent yet those that had cattle and sheep numbers that were more than 400 experienced an increase by 3.6 percent. Comparing all the percentages, households with cattle and sheep numbers that were between 301 and 400 experienced a decline in 2012, but generally, households kept more numbers of cattle and sheep in 2012 than in 2008.

Table 3
Descriptive statistics of livestock numbers in 2008 and 2012

Cattle and sheep Numbers	2008	2012	Percentage (2008)	Percentage (2012)	Percentage change
<100	207	178	82.8	71.2	11
100–200	29	46	11.6	18.4	6.8
201–300	6	10	2.4	4	1.6
301–400	6	5	2.4	2	0.4
>400	2	11	0.8	4.4	3.6
Note: N (list wise)=250.					

Socio-economic factors that affected smallholder cattle and sheep numbers

The results of the estimated coefficient for the OLS multiple regressions are presented in Tables 4 and 5 respectively following the lead of (Omotayo and Oladejo, 2016). Table 4 shows that seven out of twenty independent variables significantly affected livestock numbers in 2008. Table 5 shows that only five out of the twenty one independent variables significantly affected livestock numbers in 2012. The following independent variables were found to have significant effect on livestock numbers in 2008 and 2012 combined.

District had a negative but statistically significant effect ($p<0.10$) on livestock numbers in 2012 as indicated in Table 5. Livestock ownership decision is highly dependent on the climate in which the farm is located; for example, when water flow is high in a district, the district is more likely to have more livestock (Seo et al., 2008). Hence the more favourable the agro-ecological conditions are, the higher the livestock numbers expected in a particular district.

Household size had positive and statistically significant effect ($p<0.10$) on livestock numbers in 2008. Household size is the key factor in driving the labour availability for farming practices; timely completion of tasks by family labour is important in small-scale agricultural practices (Moyo, 2010; Omotayo, 2016). Successful management of large herds for the maximum benefit of the household requires the labour from certain members of the family of both genders (Majekodunmi, 2011).

Livestock numbers in 2008 had a positive and statistically significant effect ($p<0.01$) on livestock numbers in 2012 in the OLS regression result in Table 5. The report on natural livestock statistics of South Africa shows that only cattle and pig numbers increased in 2008 (NDA, 2009). In 2012, the same statistics show that the numbers for cattle, sheep, pigs and goats all increased in South Africa by November 2012 (NDA, 2013). Similarly, the results from the surveys carried out by the UK's agricultural department in December 2012 show that the total

number of cattle and calves in the UK increased in 2012, as against the trend of declining cattle numbers since 2005 at the same time of the year (DEFRA, 2013).

Planted pasture had a negative but significant effect ($p<0.01$) on livestock numbers in 2008 but its effect was not significant in 2012 as indicated in the results in Table 5. This may be due to the reliance on natural veld as the only form of feeding livestock, by the majority of the smallholder cattle and sheep farmers in the province. Alemayehu (1998) estimates that 80-85 percent of the livestock feed comes from natural pasture. High grazing pressure on the natural pastures however, results in overgrazing, leading to further degradation of the vegetation resources (Macharia and Ekaya, 2005).

Present grazing land condition had a significant but negative effect ($p<0.10$) on livestock numbers in 2008. This implies that deteriorations in grazing land condition could possibly have adverse effect on herd size. Macharia et al. (2005) indicated a downward trend in range conditions, which have even affected livestock productivity over past three decades. Macleod et al. (2004) assessed the impact of grazing land condition on livestock performance using three different grazing land conditions in northern woodlands. The results indicated that a lower stocking rate is warranted as grazing land condition deteriorated.

Grazing land acquisition did not indicate any significance in 2008 but had a significant but negative effect ($p<0.05$) on livestock numbers in 2012. The results in Table 5 show that a unit increase in grazing land acquisition result in 22.3 percent decrease in livestock numbers. Studies have revealed that the major production constraint to expanding farming is lack of grasslands due to increased population pressure. Farmers who wish to increase their livestock numbers cannot do so due to difficulty in obtaining additional grazing land (Premaratne et al., 2003; Vithanage et al., 2014).

Service, advice/training had a significant but negative effect ($p<0.05$) on livestock numbers. Various extension services in agriculture have been designed to provide services, advice and training to smallholder farmers. Despite wide-ranging reform initiatives in agricultural extension, the access to and quality of information provided to marginalized and poor farmers is still uneven (Glendenning et al., 2010). Some of the reasons why provision of agricultural services, advice and training may fail are general lack of capacity to provide the services in terms of staff and resources; lack of appropriate management of the service to make it effective and focus on outcomes; lack of political priorities to provide the services; and lack of knowledge about the relevance of the wellbeing of the farmers (Mogues et al., 2009).

Veterinary services had a significant but negative effect ($p<0.10$) on livestock numbers, as indicated in Table 4. Farmers sometimes lacked the knowledge and resources for treatment and control because of poor availability and updating of veterinary services. Vithanage et al. (2014) observed that poor veterinary services are the major production constraints faced by dairy farmers.

Purchase of dosing products had a significant but negative effect on livestock numbers in the OLS regression result for 2008 (Table 4). However, in 2012 the effect was positive and significant at 10 percent level of significance ($p<0.10$). Quality dose products are expensive but still much more effective. Majekodunmi (2011) states that the purchase of veterinary drugs is most significant cost associated with cattle production, it accounts for about 43 percent of the total production cost. Some livestock farmers have alternatives to Western drugs and use locally available remedies for curing and preventing diseases (Moyo, 2010). Cassini et al. (2008) similarly observed that livestock farmers used traditional medicines for their livestock treatment because the costs of modern veterinary drugs were perceived to be high.

Sales per year had a significant and positive effect on livestock numbers in both years. The study by Lubungu et al. (2012) shows that as herd size increases, the proportion of households selling that particular type of livestock also increases. For many smallholder farmers, the sale of livestock provides the only outlet to the cash economy; livestock sales contribute 78 percent of the cash income for smallholder mixed crop and livestock farms (Kuriuku et al., 2013).

Comparing the two regression results, the independent variables found to significantly affect livestock numbers in both 2008 and 2012 were district, household size, livestock numbers in past year (2008), planted pasture, grazing land condition, grazing land acquisition, service, advice/training, veterinary services, purchase of dosing products and sales per year. The R^2 values from the OLS multiple regression analysis for livestock numbers in 2008 and 2012 were 0.666 and 0.644 respectively. This indicated that the explanatory variables explain about 66.6 percent and 64.4 percent of the total variation in livestock numbers in 2008 and 2012 respectively. The value for R^2 also indicated that other explanatory variables not included in this study would affect the variation in livestock numbers by 33.4 percent and 35.6 percent in 2008 and 2012 respectively.

Table 4
ORDINARY LEAST SQUARE MULTIPLE REGRESSION RESULTS (2008)

Variable	B	S.E	t-value	Significance
Dependent variable				
Y=Livestock numbers (2008)				
Independent variables				
X1=District	0.038	0.061	0.625	0.533
X2=Household size	0.231	0.129	1.785	0.076*
X3=Gender	-0.192	0.172	-1.114	0.266
X4=Age (Years)	-0.007	0.067	-0.099	0.921
X5=Level of education	-0.031	0.048	-0.644	0.52
X6=Years of experience	0.054	0.042	1.291	0.198
X7=Household income(Rand per year)	-0.08	0.096	-0.832	0.406
X8=Farm ownership	0.007	0.032	0.212	0.832
X9=Camp system	-0.108	0.126	-0.857	0.392
X10=Natural veld/grazing	-0.979	0.948	-1.032	0.303
X11=Planted pasture	-0.577	0.183	-3.144	0.002***
X12=Present grazing land condition:	-0.117	0.059	-2	0.047*
X1=Grazing land acquisition	-0.08	0.067	-1.185	0.237
X14 = Services, advice and Training	-0.286	0.129	-2.211	0.028**
X15=Veterinary services	-0.264	0.134	-1.975	0.049*
X16=Transportation	0.084	0.126	0.669	0.504
X17= Vaccine and inoculation	0.137	0.128	1.072	0.285
X18= Purchase of dosing Products	-0.448	0.13	-3.451	0.001***
X19=Major objective	0.05	0.102	0.487	0.627
X20=Sales per year (2008)	0.683	0.103	6.621	0.000***
Note: ***P<0.01; **P<0.05; *P<0.10; Number of cases=250; R-Square=0.666.				

Table 5 ORDINARY LEAST SQUARE MULTIPLE REGRESSION RESULTS (2012)				
Variable	**B**	**S.E**	**t-value**	**Significance**
Dependent variable				
Y=Livestock numbers (2012)				
Independent variables				
X_1=District	-0.159	0.087	-1.837	0.068*
X_2=Household Size	0.042	0.184	0.227	0.82
X_3=Gender	0.118	0.248	0.476	0.635
X_4=Age (Years)	0.142	0.095	1.488	0.138
X_5=Level of education	0.088	0.068	1.289	0.199
X_6=Years of Experience	-0.093	0.06	-1.553	0.122
X_7=Household income(Rand per year)	0.169	0.135	1.252	0.212
X_8=Livestock numbers in 2008	0.763	0.072	10.53	0.000***
X_9=Farm ownership	-0.01	0.046	-0.214	0.831
X_{10}=Camp system	-0.202	0.18	-1.118	0.265
X_{11}=Natural veld/grazing	-0.349	1.354	-0.258	0.797
X_{12}=Planted pasture	-0.278	0.264	-1.052	0.294
X_{13}=present grazing land Condition	0.076	0.084	0.911	0.363
X_{14}=Grazing land acquisition	-0.223	0.096	-2.336	0.020**
X_{15}=Services, advice and Training	-0.076	0.185	-0.412	0.681
X_{16}=Veterinary services	0.069	0.192	0.358	0.72
X_{17}=Transportation	-0.158	0.18	-0.878	0.381
X_{18}=Vaccine and inoculation	0.141	0.183	0.767	0.444
X_{19}= Purchase of dosing Products	0.346	0.188	1.836	0.068*
X_{20}=Major objective	-0.002	0.146	-0.012	0.991
X_{21}=Sales per year (2012)	0.87	0.195	4.469	0.000***
Note: ***P<0.01; **P<0.05; *P<0.10; Number of cases=250; R-Square=0.644.				

CONCLUSION

Cattle and sheep numbers in 2008 had a significant effect on numbers in 2012; this implied that some of the farmers who kept small numbers of livestock in 2008 had increased their stock by 2012. Farmers who kept few numbers of livestock in a previous year were able to make enough income from livestock sales to increase or rebuild their stock in following year or years after.

Planted pastures negatively affected livestock numbers. It can be concluded that the majority of the smallholder cattle and sheep farmers in the province depended on natural veld for grazing, and it was only farmers who had planted pastures that were more likely to cope better with feed and feeding-related problems as planted pastures could be used to relieve the pressure on the natural veld, reduce the quantity of conserved feed and thereby improve the performance of the livestock.

Grazing land condition also had a significant but negative effect on livestock numbers. As grazing land condition was degraded, farmers were forced to cut down the stocking rate in order to meet the feed requirements of the livestock. Grazing land acquisition had a negative effect on livestock numbers. It can therefore be concluded that farmers who did not cut down on their stocking rate would overstock and reduce quality of grazing land, thereby ending up with unproductive animals with low market value.

Service, advice/training had a significant but negative effect on livestock numbers. Majority of the smallholder farmers encountered problems in getting the services, advice and training they required to improve on desired farming practices. Conclusions were that access to and quality of information provided to marginalized and poor farmers had improved but was still uneven despite wide-ranging reform initiatives in agricultural extension services. Farmers' access to veterinary services had a significant but negative affect on livestock numbers. It was concluded that even though veterinary services in the area have improved, farmers still lacked the knowledge and resources for disease treatment and control because of poor availability and updating information on veterinary services.

Purchase of dosing products significantly affected livestock numbers but negatively. It can be concluded that farmers encountered problems with purchasing quality dosing products even though they are more effective, most likely due to the high cost and lack of storage facilities such as coolers or fridges to properly preserve the dosing products before or after use. Under these circumstances livestock farmers are forced to develop alternatives to Western drugs and use locally available remedies which are sometimes not as effective for curing and preventing diseases. Sales of livestock per year had a significant and positive effect on livestock numbers. The conclusion is that farmers generated enough income from the sale of livestock to enable them to meet expenses such as the purchase of more breeding stock, feed and supplements, which would help them increase and improve the productivity and overall performance of the livestock they kept.

RECOMMENDATIONS

Municipalities should make more commonage land available to the smallholder farmers in order to cope with the increasing population of emerging farmers. Commonage land management should be strengthened. It is also recommended that policies that provide guidance on how different groups of farmers should utilize the same commonage land should be strictly applied. Smallholder livestock farmers should be encouraged to engage in camp systems and practise rotational grazing. This will reduce overgrazing and uncontrolled breeding, as dividing land into camps will allow male and female animals to be separated and ensure that mating is only allowed when conditions are favourable.

Smallholder cattle and sheep farmers should be trained to make reserves such as hay and silage so they can conserve surplus forage in rainy seasons. They should also be advised to plant fodder plants to reduce pressure on the natural veld, and also to introduce legumes into their pastures in order to produce forage throughout the year. Farmers can also increase the land's productivity by establishing fodder grass and fodder shrubs along contour bands.

Macharia et al. (2010) similarly states that one way of improving the productivity of range lands is through integrating forage legumes into natural pastures, especially in smallholder livestock production systems. This could lead to enhanced forage production and increased grazing periods, as legumes can remain green long after grasses have dried (Macharia et al., 2010).

Extension and veterinary services should be strengthened. Extension officers should be well distributed and well equipped with necessary resources, which will enable them to increase their coverage in terms of the numbers of farmers they reach. Extension officers should give timely and professional advice on overall management practices which will assist farmers to improve their livestock activities as well as their standard of living.

Government should provide subsidies for purchase of breeding stock and dosing products. Distribution policies that will ensure that all smallholder cattle and sheep farmers at grassroots level benefit should also be put in place. This should enable smallholder cattle and sheep farmers to cope with the high transactional costs associated with purchasing equipment and facilities (e.g. windmills, crawl pens, head clamps, dipping tanks, veterinary drugs and feed supplements).

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