S.Afr. Tydskr. Landbouvoorl./S. Afr. J. Agric. Ext., Conradie & Landman
Vol. 43, No. 1, 2015: 22 – 31
ISSN 0301-603X (Copyright)

WOOL VERSUS MUTTON IN EXTENSIVE GRAZING AREAS

Conradie, B.[4], Landman, A.[5]

Corresponding author: Beatrice.Conradie@uct.ac.za

ABSTRACT

This paper investigates the relative profitability of woolled and mutton sheep under field conditions in an extensive grazing area. The dataset comprises 34 fulltime farmers and 75% of the sheep in the district. There was no difference in unit production costs or net farm income per sheep in the flock. Dorper flocks recorded higher lambing rates and Merinos lower rates of predation, which deserves further investigation. The percentage woolled sheep in the flock was modelled as a logit function of farm size, crop area, tradition and terrain ruggedness, although the latter was not significant. These results confirm earlier recommendations that reproductive efficiency must be carefully monitored in Merino flocks. The extension message is that on average there is no financial advantage to woolled sheep production, although this could change if woolled flocks could be made more productive. The wool industry must not stop serving these extremely arid areas.

Keywords: financial performance, sheep breeds, arid conditions, extension implications

1. INTRODUCTION

Over the last fifty years South Africa experienced a dramatic change in the composition of its sheep flock. Figure 1 shows that this change was primarily driven by a change in the relative prices of wool and mutton, which increasingly favoured mutton over woolled sheep. In the mid-1950s there were thirteen woolled sheep for every mutton sheep in the Central Karoo, while by 2002 this figure had declined to barely two woolled sheep for every mutton sheep. The question is whether perhaps the conversion to mutton sheep has overshot the ideal level.

In South Africa woolled sheep are primarily Merino types, while mutton sheep is dominated by the Dorper breed. We have come across a handful of farmers who run Merino cross breeds or mutton sheep with elements of indigenous sheep in them, but for the purpose of this discussion any sheep with a marketable wool crop is described as a Merino while all mutton sheep are considered to be Dorpers. Since goats comprise less than 3% of total small stock holdings in the study area, they were not considered in this analysis.

The relative performance of woolled and mutton sheep hinges on the size and value of the wool clip compared to the size and value of the additional fertility that can be achieved with mutton sheep. This relationship is probably modified by rainfall; Olivier, Snyman, Olivier, Van Wyk & Erasmus (2001) recorded the detrimental effect of low rainfall on long run fertility of Merino sheep, while Dorper sheep are believed to be less sensitive to adverse grazing conditions than Merinos (Cloete, Snyman & Herselman, 2000). Since these findings refer to experiment station conditions, it is an open question which is best under field conditions in an arid area. The choice of Laingsburg as study site represents a worst case

[4] Associate professor in the School of Economics and Director of the Sustainable Societies Unit in the Centre for Social Science Research at the University of Cape Town.
[5] Production advisor, National Wool Growers Association, Caledon

scenario for Merinos, as the area's low rainfall of less than 130 millimetres per year is expected to favour Dorpers. If Merinos can beat Dorpers in Laingsburg it is likely that they will do so everywhere in South Africa; if there is no difference or if Dorpers do better than Merinos in this area, the question for the wool industry becomes one of appropriate geographic boundaries for its extension efforts. Clearly the wool industry does not want to waste time and money on promoting woolled breeds in areas where these do not have a comparative advantage.

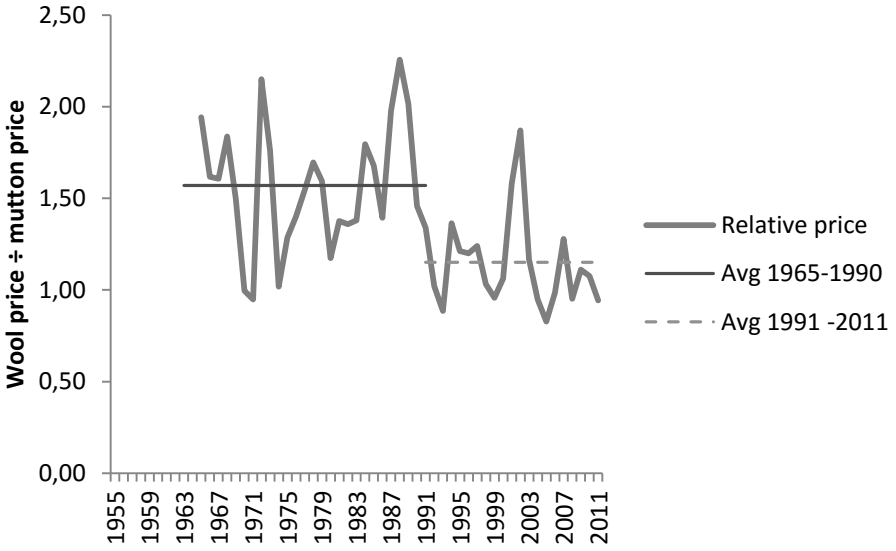

Figure 1: The relative price of greasy wool to dressed mutton (Source: DAFF, 2013)

This study investigates two key questions, namely "What is the relative profitability of Merino and Dorper flocks under field conditions?" and "In what other ways do these two flocks differ from each other?" Section 2 describes the dataset and the manipulation of key variables. The results are presented in Section 3 and the extension message summarised in Section 4. The paper ends with brief conclusions.

2. METHODS

This analysis uses a cross section dataset collected in a questionnaire survey which ran in Laingsburg district in November 2012. The survey targeted all landholders regardless of their ownership status or whether they are full-time or "weekend" farmers. The resulting convenience sample achieved good coverage; of the 64 landholders approached 58 agreed to be interviewed (91%) and 54 returned questionnaires complete enough to be analysed (84%). The sample of farmers contacted and the 36,000 small stock units on which data were collected, represent 80% of the farmers and 77% of the sheep recorded for Laingsburg in the 2002 farm census (Statistics South Africa, 2006).

Trust is recognised as being able to substantially improve quality of data gathered in questionnaire surveys (Robel, Dayton, Henderson, Meduna & Spaeth., 1981). To build trust, local community leaders including a church elder, the chairman of the Land Care committee and various farmers' union representatives were recruited into the Laingsburg survey first and then asked to assist with compiling the convenience sample. Interviews were conducted in Afrikaans by an Afrikaans-speaking person with a formal qualification in agriculture. The

high response rate attests to good general acceptance of the research, but it helped that interviews were conducted as informal conversations in the home of the respondent.

The unit of observation was a farm or flock which could consist of multiple types of small stock. Multiple parcels of land managed together were considered to be a single farm. Most people had one or two parcels of land and the maximum was eight. Operations in different districts were not considered.

To minimise strategic responses, the survey collected raw livestock numbers rather than reproductive percentages. Although other authors have used different definitions, in this case all reproductive efficiencies were expressed per ewe in the flock. For example if a flock of a hundred ewes produce eighty lambs of which ten dies, fifty are sold and twenty are kept back for replacement, then the lambing or tagging percentage would be 80%, the loss rate would be 10%, the sales rate 50% and the replacement rate would be 20%. Intentionally the survey also did not collect the number of ewes kept back for replacement, but instead calculated this figure as the difference between the number of lambs born and the sum of lamb sales and losses. Farmers tell us that a ewe's productive life in their area is between five and six years. This age range provides a convenient check of internal data validity. The sample average replacement rate of 17% and the fact that 80% of the observations fell inside a plausible range were quite reassuring. However, the high standard deviation of 11% on this variable is a possible indication of poor data quality.

The subsample whose data is analysed here was restricted according to the share of household income derived from farming and the importance on sheep on the farm. Farm income varied from 1-100% of household income with a mean of 78%, which suggests that most of landholders in the area are fulltime farmers. Sheep's share of farm income varied from 7% - 100%, with a mean of 81%, which indicates that this is still primarily a sheep farming area. Farm income had to contribute at least 60% of household income while sheep had to contribute at least 70% of farm income for a farm to be selected for this analysis. All farmers who reported any number of Merinos, Dohne Merinos or Afrinos were classified as wool producers regardless of the percentage woolled sheep in their flocks (n=14). No other wool breeds were encountered. The remaining twenty producers run mutton sheep only, primarily Dorpers. The initial partitioning resulted in a 40% difference in average farm size between woolled and mutton flocks. We controlled for farm size by dividing the mutton group into two groups of farms above and below 6,000 hectares. This resulted in a median farm size for the large mutton group which was within twenty hectares of median farm size for the wool producers. In the cross category comparisons which follow we present two sets of ANOVA results, one which tests for differences across all three categories and therefore does not control for farm size and one which tests for differences across similar sized wool and mutton flocks only and therefore in a way does control for farm size. The analysis of variance tests were conducted in Excel.

On the advice of Winter, Prozesky & Esler (2007), sensitive income questions were avoided in the questionnaire to protect response rate. Instead income was estimated from production data. The reproductive rate and the lamb crop sold gave an indication of the total number of slaughter lambs produced in 2012. This was multiplied by the local sales price for slaughter lambs of R1000 each to get gross income. To estimate the value of the wool clip the estimated mutton income was divided by its reported share of farm income and multiplied by wool's reported share of farm income. For example, if a farmer says that the gets two thirds of his farm income from mutton and one third from wool and reports a sales percentage of

57%, his meat income would be R1000 x 0.57 = R570 per ewe in the flock. The corresponding wool revenue would be R570/0.67*0.33=R281, which produces total gross revenue of R851 per ewe. Costs were collected directly and in two missing cases estimated from the sample average. While the difficulty of assigning overhead costs to a particular enterprise often limits enterprise comparisons to the gross margin[6] level (Standard Bank, 1988), here overheads were allocated according to sheep's share of gross farm income. The calculation is pre-tax and represents payments to own (e.g. owner's salary) and foreign fixed factors (e.g. cost of finance).

If it can be shown that Merinos are more profitable than Dorpers, it would be useful for extension officers to know what explains current woolled sheep ownership. This question can be approached variable by variable or by specifying a multivariate regression model in which a combination of factors are considered together. While the latter is preferable, the small sample size of n=34 seriously limits the complexity of such a model.

A histogram of the percentage woolled sheep in the flock suggested the need for a limited dependent variable model. We ran logit using the maximum likelihood routine in Stata 13.0.

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha_0 + \alpha_1 \text{Opportunity cost of the owner's time}_i + \alpha_2 \text{Management skills}_i + \alpha_3 \text{Resource endowment} + \alpha_4 \text{Tradition}_i + \varepsilon_i \quad [1]$$

The left hand side of equation 1 proxies a latent variable which measures the "net benefit" of woolled sheep ownership. Four factors were theorised to influence this variable, namely the opportunity cost of the owner's time, management skills, the resource endowment of his farm and family tradition. If it is true that Dorpers are easier than Merinos, people with other claims on their time, be it crop farming (Elliot, Sneddon, Lee & Blache, 2011) or off-farm work (Kumm, 2009), would be less inclined to farm with Merinos than people without these other commitments. Unfortunately be restricting the sample to individuals who derive 60% or more of household income from farming, virtually all male off-farm employment was eliminated which meant that the opportunity cost effect could only be tested with extent of crop farming. Years of schooling and a dummy variable indicating if rainfall records are kept were used to capture management quality. We also experimented with years of farming and farm management experience, but abandoned both these variables as they were highly correlated (r >0.7) with farmer age. The other possibilities such as how frequently sheep are counted or whether a fixed breeding cycle is followed were not viable as they are co-determined with breed selection. The percentage Merinos was expected to increase with management quality, again because of the perception that better farmers keep woolled sheep.

Under resource endowment we considered farm size and terrain ruggedness (and would have liked to include rainfall, which was only available in a third of cases). We expected the probability of woolled sheep ownership to increase with farm size as cash flow constraints are more severe for the owners of small properties. On the other hand, the relationship could run the opposite way because Dorpers are hardier than Merinos. Terrain ruggedness, proxied

[6] Gross margin = Gross income – Directly allocated variable costs (i.e. feed, animal health, genetic improvement); Net farm income = ∑Gross margin of all enterprises – overhead costs (i.e. fuel, transport and electricity, repairs and maintenance and labour)

by the percentage of a farm that the owner describes as mountainous, was expected to increase with farm size and to favour Dorpers, that is, to be negatively correlated with the percentage woolled sheep in the flock. The argument around tradition was simply that given the historical dominance of woolled sheep in the area, older people and individuals with a longer family history on the land would have more experience with woolled sheep and therefore more likely to continue to farm with it than newcomers and younger farmers.

3. RESULTS

Farmer age varied from 29 to 79, with one in three farmers being aged sixty or above. Farmer education varied from incomplete high school to postgraduate degrees, with a two-year agricultural diploma being the most frequently reported qualification. Family history on the land varied from four to 192 years, with an average of occupation of 87 years. Almost 90% of the land in our sample was owner operated and 79% of farmers reported farming on more than one parcel of land. A third of farms were reported to be above 10,000 hectares, while 21% of farms were below 4,000 hectares. Almost 60% of farms have no irrigated land; for the remainder irrigated area varied from 0.5-17 hectares, with fodder crops accounting for two thirds of the irrigated area and fruit and vegetable seed for the rest.

Table 1: Profitability of woolled versus mutton sheep flocks in 2012 prices (Rand /ewe)

				ANOVA F-statistic[1]	
	Dorper >6,000ha n=8	Merino n=14	Dorper <6,000ha n = 12	Not controlling for size[2]	Controlling for size[3]
Purchased feed and fodder	49.82	62.61	100.98	0.813	0.136
Animal health	6.07	8.53	13.32	0.619	0.455
Ram purchases	12.50	9.82	17.71	0.468	0.153
Fuel, transport, electricity	46.63	79.64	136.58	3.775**	2.429†
Repairs, maintenance	62.75	50.79	52.00	0.151	0.284
Labour	66.38	66.43	72.00	0.035	0.000
Total cost[2]	**243.88**	**277.71**	**392.33**	**1.272**	**0.206**
Mutton gross revenue	568.42	424.02	774.47	3.582***	2.201
Wool gross revenue		245.52		16.52***	13.175***
Total gross revenue	**568.42**	**669.55**	**774.47**	**0.800**	**0.581**
Net farm income	**324.63**	**391.86**	**382.00**	**0.085**	**0.206**

[1] ***p <0.01, ** p<0.05, *p<0.10, †p<0.15 [2] All groups [3] Two way comparison of large farms only

The flocks in our sample varied from 187-1,850 sheep with a mean size of 782 breeding ewes. Sixteen farmers ran Dorpers exclusively (47%), eleven farmers had a combination of Dorpers and Merinos (29%) and just seven producers operated pure Merino flocks (21%). Dorpers comprised 21% of the flocks that were classified as woolled sheep flocks. Woolled sheep made up between 23% and 100% of what we classified as Merino flocks and wool

sales contributed 33% of farm income for this group. The average tagging percentage in the sample, of lambs tagged and castrated per hundred ewes in the flock, was 87% in 2012. The corresponding sales percentage of lambs sold per hundred ewes in the flock was 58% while the total loss percentage of lambs killed or lost per hundred ewes in the flock was 12%. Predation accounted for three quarters of losses. Compared to Snyman's (2010) figure of predators being responsible for 39% of kid losses in angoras in the Eastern Cape, the Laingsburg sample's predation rate as proportion of all losses was high and could indicate a degree of misdiagnosis by farmers.

The lack of significant differences in the various line items in Table 1, whether one controls for farm size or not, means that despite the 40% difference in net farm income per ewe in the flock, one cannot currently claim Merinos to be more profitable than Dorpers, or *vice versa,* under Laingsburg conditions. The lack of significance may be due to the small sample size of the current study, but with the high degree of coverage there is no guarantee that increasing the scope of the study will reduce the standard errors. It may be purely attributable to inherent differences in resource endowment or management quality. Trends nevertheless follow the expected patterns, namely that Merinos ought to be more expensive to produce and more profitable than Dorpers if one controls for size, and that small-scale systems ought to have higher unit costs than large-scale operations. There was a surprisingly small difference in unit labour expenditure and a large difference in unit energy expenditure, which especially for small Dorper farms suggests an element of private consumption.

Table 2: Selected productive and reproductive flock statistics

				ANOVA F-statistic[1]	
	Dorper >6,000ha n=8	Merino n=14	Dorper <6,000ha n = 12	Not controlling for size[2]	Controlling for size[3]
Veld (ha/ewe)	12.9	11.5	10.8	0.532	0.447
Irrigation (ha/100ewes)	0.11	0.18	1.40	0.429	0.163
% mountain	11	13	2	1.744	0.070
Pregnancy testing[4]	2.3	3.5	2.0	2.998*	2.696†
Animal health routine[4]	3.3	4.4	4.3	4.003**	7.754**
Counting interval (days)	89	44	76	0.888	1.821
Rainfall data (1=yes)	0.375	0.571	0.417	0.472	0.741
Tagging percentage	0.94	0.70	1.03	4.790**	6.855**
Predation percentage	0.19	0.07	0.06	11.154***	15.077***
Other loss percentage	0.01	0.04	0.01	2.058†	2.172

[1] ***p <0.01, ** p<0.05, *p<0.10, †p<0.15; [2] All groups;[3] Two way comparison of large farms only; [4] Importance of practice on a 5 point Lickert scale where 1 = unimportant

The average total revenue was R682.78 per ewe in the flock and comprised 85% meat sales and 15% wool income. The total cost of production was R310.20 per ewe. Overheads, consisting of labour (22%), fuel, transport and electricity (30%) and repairs and maintenance (17%), accounted for 69% of total costs. Purchased feed and fodder accounted for three quarters of directly allocated variable costs, which made up 31% of total cost. The net farm income of R372.38 per ewe in the flock was similar to the R388 and R399 per ewe reported for Calvinia in 2009/10 and 2010/11 (Geyer, Van Heerden & Venter, 2011).

Table 2 shows that the three groups have the same stocking rates and use the same amount of irrigated pastures. The difference in terrain ruggedness disappeared when we controlled for farm size. Pregnancy testing (by means of sonar scan or visual inspection) was considered more important by the Merino owners than by Dorper owners, who think of it as unimportant. Merino and small Dorper farmers both indicated an animal health routine to be important, while the managers of large Dorper flocks tended to consider it to be unimportant. Although the frequency of events during which sheep are handled and counted varied by a factor of two across groups, the difference was not significant.

Table 3: Logit results explaining the probability of Merino ownership

	Model 1	Model 2	Model 3
Irrigated area (ha)	-0.2718		-0.2836†
	0.2013		0.1950
	-0.0497†		-0.0545*
Education (years)	0.0793		
	0.3779		
	0.0145		
Rainfall records D	1.3556		
	1.4405		
	0.2457		
ln(Farm size)	5.6534**	2.1061**	5.5452**
	2.9156	0.9051	2.7882
	1.0333***	0.5090**	1.06489***
Mountains (%)	0.0348		0.0407
	0.0408		0.0359
	0.0064		0.0078
ln(Farmer age)	-1.3142		
	3.2942		
	-0.2402		
ln(Family history on land)	4.0673†	1.6554*	4.5977*
	2.6857	0.9464	2.6075
	0.7434**	0.4001*	0.8829**
Constant	-65.235*	-26.286**	-70.120**
	34.043	10.808	35.494
Observations	30	32	32
Wald LR stat	19.16***	9.42***	18.12***
McFadden's R^2	0.4668	0.2148	0.4414
Akaike's info criterion	38	40	33
Schwartz's BIC	49	45	40
Predicted % woolled sheep	24%	41%	26%

***p<0.01, ** p<0.05, *p<0.10, †p<0.15

We recorded significant differences in tagging and predation percentages. The average tagging rate for Merinos was 26 percentage points lower than the average for Dorpers but surprisingly Merinos also had a lower predation rate. It is hard to imagine why Merinos would be more resilient against predators than Dorpers, except that perhaps the higher prevalence of twins in Dorpers or the breed's more spread out grazing habit could make new born lambs more vulnerable than Merino new born lambs. Alternatively the owners of Merino flocks could just be better managers than the owners of Dorper flocks, although this theory is not supported by the counting interval data in Table 2.

The results in Table 3 explain the probability of Merino ownership with farm and farmer characteristics. As anticipated none of the variables in Model 1 except farm size is significant, although the model accounts for almost half of the observation variation in the dependent variable and correctly predicts the observed prevalence of Merinos. In Model 2 we achieve individual significance on farm size and the proxy for tradition, but the overall fit is much worse than that of Model 1. For example, McFadden's pseudo R-squared is down and the information criteria measures are up, which indicates miss specification. Model 3 is a compromise which has almost similar explanatory power and specification results as Model 1 and yet produces significant coefficients on three variables. It uses crop area, farm size, terrain ruggedness and tradition to explain Merino prevalence. The only variable not to be significant is terrain ruggedness, but controlling for it improves the estimates on the other variables. The interpretation of the marginal effects on the significant variables is as follows: Farm size has the biggest impact. A 1% increase in farm size produces a 1.06% increase in the likelihood of owning Merinos. Tradition has a slightly smaller impact than farm size with a 1% increase in the duration of family presence on the land translating into a 0.88% higher probability of owning Merinos. Although unfortunately there is no time series data available for it, anecdotal evidence suggests that these results indicate stickiness to the adjustment process which is compounded on larger, more profitable farms. In comparison the opportunity cost effect captured by crop area is tiny; the probability of Merino ownership declines by a mere 0.05% for every additional irrigated hectare.

4. IMPLICATIONS FOR A WOOL INDUSTRY EXTENSION PROGRAMME

It is widely accepted that maintaining adequate reproductive efficiency is a critical element of financial success in Merinos (Olivier et al., 2001; Snyman & Herselman, 2005; Geyer et al., 2011). However, farming systems normally perform somewhat worse under field conditions than under experimental conditions, and even more so in marginal areas. Experiment station evidence that woolled sheep outperform mutton flocks should therefore not automatically be generalised to field conditions in a particular marginal area such as Laingsburg. In fact, the Laingsburg survey failed to establish that Merino flocks did statistically better than Dorpers during the 2012 season. The main reason for this state of affairs was that the Merino flocks recorded an almost 30% lower lambing (tagging) percentage than the mutton flocks.

For the individual extension officer the implications of these results are as follows: Firstly, if no improvement programme is put in place, it would be disingenuous to promote woolled sheep over Dorpers under these conditions. Secondly, the relative performance of the two breeds is likely to vary with rainfall and grazing conditions on the one hand and commodity prices on the other. Therefore before a conclusive answer could be given regarding the optimal breed for the area, long term data is required. The best way to do such long term monitoring is to establish a study group in the area. This is something which an extension agent or veterinary technician on the ground can easily do without much funding.

Participation in this group should be open to mutton and wool producers and should be as unintimidating as possible. Ways in which this can be ensured include simple paperwork, regular extension visits and regular meetings of the study group. The results should be better management skills which should translate into better reproductive performance regardless of breed choice, although it might just give Merinos the edge for the marginal farmer.

Finally from a wool industry perspective there is a bigger question, namely whether it is worthwhile to commit time and money to promoting woolled sheep in very marginal areas. Whilst it is true that Laingsburg used to produce more than 600,000 kilograms of wool during the 1950s and 1960s, woolled breeds' relative superiority can no longer be taken for granted. Commodity prices and input costs have all changed which could affect relative profitability. Furthermore there is growing evidence of climate change, the effect of which on the fertility of sheep nobody has really studied. This variability and the need to optimise scarce industry resources call for the kind of long term monitoring described above to be industry-wide.

5. CONCLUSIONS

This paper investigated the relative profitability of Dorper and Merino flocks under field conditions in an arid grazing area, and found there to be no significant difference between the breeds for the Laingsburg district for the 2012 season. Farmers should be informed that woolled sheep can compete with Dorpers under extensive grazing conditions if reasonable reproductive rates are maintained. The wool industry extension service should include Laingsburg in its programme of work but should actively work towards improving Merinos' relative reproductive performance in this area.

REFERENCES

CLOETE, S. W. P., SNYMAN, M. A. & HERSELMAN, M. J., 2000. Productive performance of Dorper sheep. Small Rumin. Res. 36: 119-135.

DAFF (DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY), 2013. Abstract of Agricutlural Statistics. Pretoria.

ELLIOT, J., SNEDDON, J., LEE, J. A. & BLACHE, D., 2011. Producers have a positive attitude toward improving lamb survival rates but may be influenced by enterprise factors and perceptions of control. Livest. Sci. 140: 103 -110.

GEYER, A. C., VAN HEERDEN, C. & VENTER, J., 2011. Oorsig van Merino boerdery in die Calvinia omgewing Merino Focus 2011: 58-59.

KUMM, K. I., 2009. Profitable Swedish lamb production by economies of scale. Small Rumin. Res.81: 63-69.

OLIVIER, W. J., SNYMAN, M. A., OLIVIER, J. J., VAN WYK, J. B. & ERASMUS, G. J., 2001. Direct and correlated responses to selection for total weight of lamb weaned in Merino sheep. *S. Afr. J. Anim. Sci.* 31(2): 115-121.

ROBEL, R. J., DAYTON, A. D., HENDERSON, F. R., MEDUNA, R. L. & SPAETH, C. W. 1981. Relationships between husbandry methods and sheep losses to canine predators. *J. Wildlife Manage.* 45 (4): 894-911.

SNYMAN, M. A., 2010. Factors affecting pre-weaning kid mortality in South African angora goats. *S. Afr. J. Anim. Sci.* 40(1): 54-64

SNYMAN, M. A. & HERSELMAN, M. J., 2005. Comparative productive and reproductive efficiency of Afrino, Dorper and Merino sheep in the False Upper Karoo. *S. Afr. J. Anim. Sci.* 35(2): 98-108.

STANDARD BANK, 1988. Finance and farmers – A financial management guide to farmers. 2nd Edition. Standard Bank Head Office, Johannesburg

STATISTICS SOUTH AFRICA, 2006. Census of Agriculture Provincial Statistics 2002: Western Cape. Central Statistical Service report no 11-02-02 (2002), Pretoria.

WINTER, S. J., PROZESKY, H. & ESLER, K. J. E. 2007. A case study of landholder attitudes and behaviour towards the conservation of renosterveld, a critically endangered vegetation type in the Cape Floral Kingdom, South Africa. Environ. Manage. 40: 46-61.