Characterization of production outputs and ewe flock structure of communal wool sheep in Ngqolowa, Eastern Cape

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Abstract

A research project was initiated to evaluate aspects regarding communal wool sheep production outputs in Ngqolowa, Eastern Cape Province. Ewes and lambs of participating farmers were observed in different seasons over a period of 5 years. The project was initiated in two phases. For the first two years only training was provided to the farmers ranging from animal handling, animal health, shearing and wool classing. From year 3, farmer training continued and in addition, genetically superior rams were introduced annually in the communal flock. During the trial the ewes and lambs were weighed and the basic age structure of the flock was determined by observing the incisor teeth on the lower jaw. The reproductive status of the ewes was determined by means of ultrasound pregnancy diagnosis. The ewe component of the flock per farmer stayed more or less constant over the trial period. Average ewe weights recorded, differed significantly between the summer and winter seasons. A stepwise regression indicated that within an age group the season affected the weight of the animals more significantly than the year of measurement. The average weight of the lambs recorded increased (b = 1.63), clean yield percentage of the wool improved (b=0.013) and net mass wool produced increased (b = 79.95) over the trial period. When expressing the value per kilogram clean wool as a ratio of the market indicator, the percentage increased from 42.3% to 55.1% (b=0.03) over years indicating that the farmers earned more rand per kilogram wool produced at the end of the trial period.

Keywords: small stock; weight; age distribution; communal farmers; rangeland resource
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Introduction

Agriculture remains the backbone of most African economies (Hussein et al., 2008). The sector is the largest domestic producer across the continent and employ between 70 and 90 % of the total labour force (FAO, 2007). In addition, agriculture supplies up to 50 % of household food requirements and up to 50 % of household incomes. There are an estimated 100,000 small-scale wool producers in the former Ciskei/Transkei area of the Eastern Cape. (Jordaan, 2011). In many rural communities, livestock is often the only asset of the poor which is also highly vulnerable to climate variability and extremes (Easterling, et al. 2007; Thornton et al., 2007; FAO, 2007; IFAD, 2010). African farmers depend on livestock for income, food, animal products and insurance (Thornton et al., 2007; Kabubo-Mariara, 2009). For rural communities, losing livestock assets could trigger a collapse into poverty and have a lasting effect on livelihoods.

Small ruminants contribute enormously towards promotion of livelihood security and as insurance (Pasha, 2000; Misra, 2005). It is common for families to rear 1-3 sheep. The animals graze on communal lands with negligible economic inputs and marginal outputs (Chauhan & Moorti, 1999).

The National Woolgrowers' Association of SA (NWGA) project "Genetic improvement of woolled sheep in the communal farming areas of the Eastern Cape" was introduced during 2002. The large-scale introduction of 3200 superior woolled rams to wool farming communities annually is one aspect of the larger project that entail both training and technology transfer as well as the introduction of superior genetic material. Communal rams are replaced by commercially bred rams on a one-to-one basis (NWGA Progress report, 2007). A research project was implemented by the Döhne Agricultural Development Institute with the aim to evaluate production outputs of woolled sheep in the communal farming areas of the Eastern Cape with regards to wool characteristics, growth and reproduction in the context of the NWGA project.

Material and Methods

The research project was implemented between 2008 and 2013. Fitting the protocol for the research trial, a community, the Ngqolowa Community, was identified. Ngolowa is in the Nkonkobe Local Municipality falls under the Amathole District Municipality. According to VEGMAP, the area is ecologically situated in the Savanna Biome on the border with the Albany Thicket Biome. Originally Acocks (1988) described the area as False Thornveld. The new vegetation classification proposed by Mucina *et al.* (2005) described the area as part of Bhisho Thornveld (SVs7) intermixed with Eastern Valley Bushveld (SVs6) and Buffels Thicket (AT12). Based on long-term modelled rainfall data, Ngqolowa receives an average rainfall of approximately 600 mm per year of which 64% falls during October – March. Average maximum temperatures vary between 21 – 29˚C and minimum temperatures between 6 – 17˚C.

Six surveys on the rangeland resource were conducted. The study area's condition was both assessed using quantitative field data and available Remote Sensing information. Based on the known boundaries, as indicated on the 1:50 000 Topocadastral map, for Ngqolowa an Area of Interest (AOI) was determined using a buffer of 1 km around the village commonage. The AOI was used to define the area for digitizing and image classification. SPOT-5 was used to digitize and map the extent of villages, abandoned and cultivated fields and stock water dams within the AOI covering the Ngqolowa Community. The descending point method, using a 200 m line transect, was used as survey method to estimate the species crown cover based on the canopy spread strikes (Roux, 1963, Du Toit, 1995 & Du Toit, 2003). This data was used to determine the species frequency and the proportional canopy spread for each species. The grazing capacity for each site was both calculated using the benchmark method as proposed by Danckwerts (1987) for False Thornveld and the method of Du Toit (2003) proposed for Karoo vegetation. The benchmark score of 714, as proposed for the False Thornveld of the Eastern Cape, was used to calculate a veld condition (Anon, 1985).

A consultation with the community was conducted before the trial commenced. The farmers are organized and have a committee that enable and mediate farming decisions taken in the community. Once the community's collaboration was secured, a general health assessment of the flock was completed. Thereafter the project was initiated in two phases. For the first two years only training was provided to the farmers ranging from animal handling, animal health, shearing and wool classing. From Year 3, rams that were genetically superior with regards to body weight and wool quality were introduced in the communal flock annually, while the training of farmers on farming practices continued. Ewes and lambs were weighed bi-annually, during summer (November/December) and winter (June/July) for the first three years of the trial and thereafter only during the summer. All farmers willing to participate were allowed to bring their sheep. Each farmer's animals were weighed separately in order to determine the owner and thus ultimately calculate owner flock sizes. During recording, the basic age structure of the flock was estimated by observing the incisor teeth on the lower jaw. An animal with two permanent incisors was classed as 2T, four permanent incisors 4T, six permanent incisors 6T and ewes with all their permanent teeth as full mouthed (F). For the purposes of the study, a lamb was defined as an animal with temporary teeth (± one year old and less) and was classed in month age groups based on owner information or when owner information was lacking an estimation of the lamb's age. The age groups were birth to younger than 3 months, between 3 and <6 months, between 6 and <9 months and 9 months and just before the first permanent teeth erupt. The reproductive status of the ewes was determined annually during March by means of ultrasound pregnancy diagnosis.

Shearing was done annually between September and November depending on when shearers were available in a particular year. Information regarding the wool quality and quantity of the communal flock was obtained from the annual broker wool sale account for the community.

Weight and age frequencies, regression analysis and ANOVA were statistically analyzed using Statistica (StatSoft, Inc. (2013). Data on wool quality and quantity was collected form the annual broker wool sales account for the Ngqolowa community.

Results

An initial consultation with the community was conducted before the research trial commenced. An initial survey on the rangeland resource was done during October 2008. Although the area was extremely dry one survey was conducted to get an impression of the vegetation. Six follow-up surveys were conducted during January 2009 over one and a halve survey days. Figure 1 presents a map with the land use patters in terms of grazing land, old lands, recently cultivated, stock water dams and settlements. Ngqolowa covers approximately 2983 ha of which 60% is used for grazing land and 32% is old lands. Currently only 0.55% of the original area transformed into croplands shows signs of active cultivation. Grazing land is mostly concentrated to the south western part of the area towards the Keiskamma River. Since the area is utilised by two communities, it was difficult to separate the communities' farming areas.

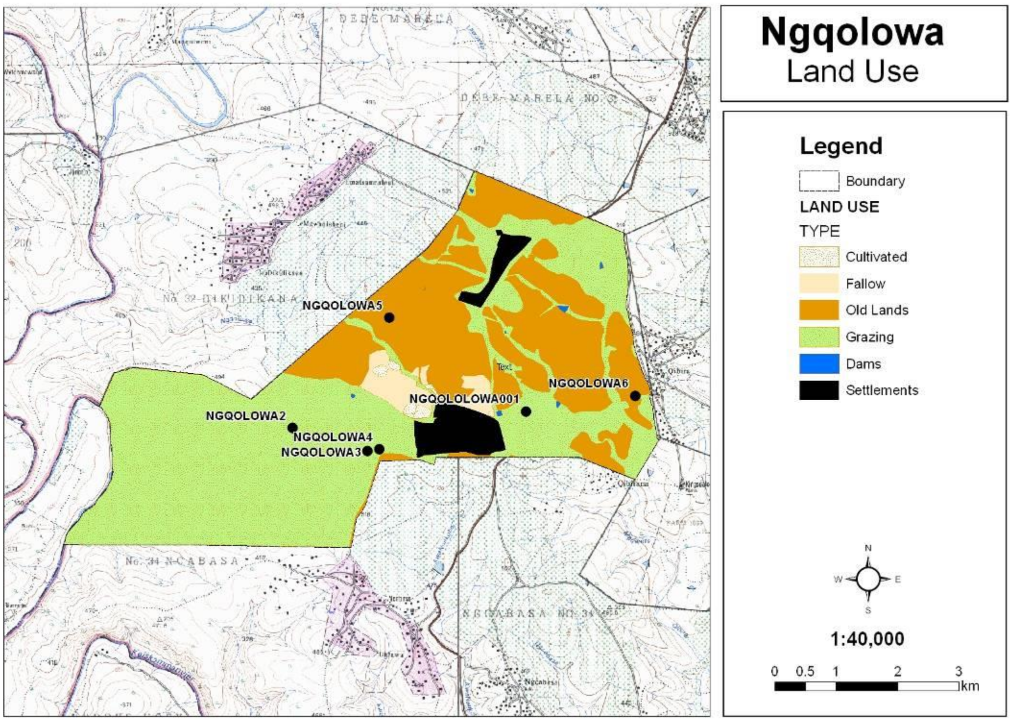

Figure 1 Land use patterns within Ngqolowa community.

The study area is situated on the transition between Bhisho Thornveld (False Thornveld) and Great Fish Thicket (Valley Bushveld) which complicates the carrying capacity for the veld. The Eastern section associated with Great Fish Thicket has a potential carrying capacity of 12 ha/LSU whereas the western section on Bhisho Thornveld has a potential carrying capacity of 3 ha/LSU. The potential grazing capacity, under good veld management and average rainfall, for the farm lies somewhere in between 3 – 12 ha/LSU. According to veld surveys the grazing capacity varies between 3 and 8 ha/LSU with an average of 6 ha/LSU. The general condition of the veld was poor with all sites except one site with a veld condition less than 50% of the benchmark (249/714). Although palatable species such as *Themeda triandra* and *Digitaria eriantha* are still dominant/ sub-dominant, karroid shrub such *as Pteronia incana*, *Chrysocoma cilliata* and *Helichrysum rosum*, *Leucas capense* and other "Karroo bossies" are already a common component of the vegetation. By assigning grazing capacity values to the polygons representing the identified broad vegetation types an approximate carrying capacity for the farm can be calculated. Based on the information the area can sustain approximately 451 LSU or 2708 SSU (1 LSU = 6 SSU).

Twenty-three farmers attended the initial consultation meeting. From this meeting the following information regarding the farming practices of the community was obtained:

- farmers estimated that they had 600 head of cattle, 800 goats and 450 wool sheep;
- most of the ewes lamb down in June and July every year;
- there is no fixed mating season;
- farmers use rams that were bred locally amongst the farmers of the community;

- lambs are not weaned, but grow up in the flock;
- there are no camps to keep rams separate from ewes outside of the mating season; and
-
- wool quality within and amongst farmers differ to a large extend. Through visual appraisal it was determined that some of the animals carry wool of very good quality, however, some of the ewes displayed large amounts of kemp in the wool.

From the general health assessment of the flock, animals were found to be healthy with no observed incidences of infectious deceases such as sheep scab.

For the purpose of the analysis, family groups were defined when sons/daughters owned sheep that were kept with their parent's sheep at the same homestead. The number of participating farmers, family groups and the number of ewes and lambs recorded in the summer seasons are presented in Table 1. The summer season is presented since the summer recordings were done over the complete trial period. Similar numbers were observed during the winter recordings in the first three years, with only lamb numbers slightly less in winter.

Table 1 The number of participating farmers/family groups, ewes and lambs recorded annually during summer

Year	**Number of farmers (Family groups)**	**Number of ewes**	**Number of lambs***
1	33 (25)	425	156
2	35 (24)	326	177
3	36 (24)	304	149
4	37 (25)	318	182
5	36 (24)	411	176

* all young animals with temporary teeth

Flock size per farmer differed from farmer to farmer but farmer flock sizes stayed reasonable constant over the five years of the trial. The farmer family group owning the largest number of animals in the communal flock owned between 15 – 17% of the animals recorded. Almost 50% of the farmers each owned less than five percent of the animals. This represents ownership of less than 20 sheep with 24% owners owning less than 10 sheep.

The age structure of the communal flock during summer and winter recordings, recorded in the first three years, are given in Figure 2.

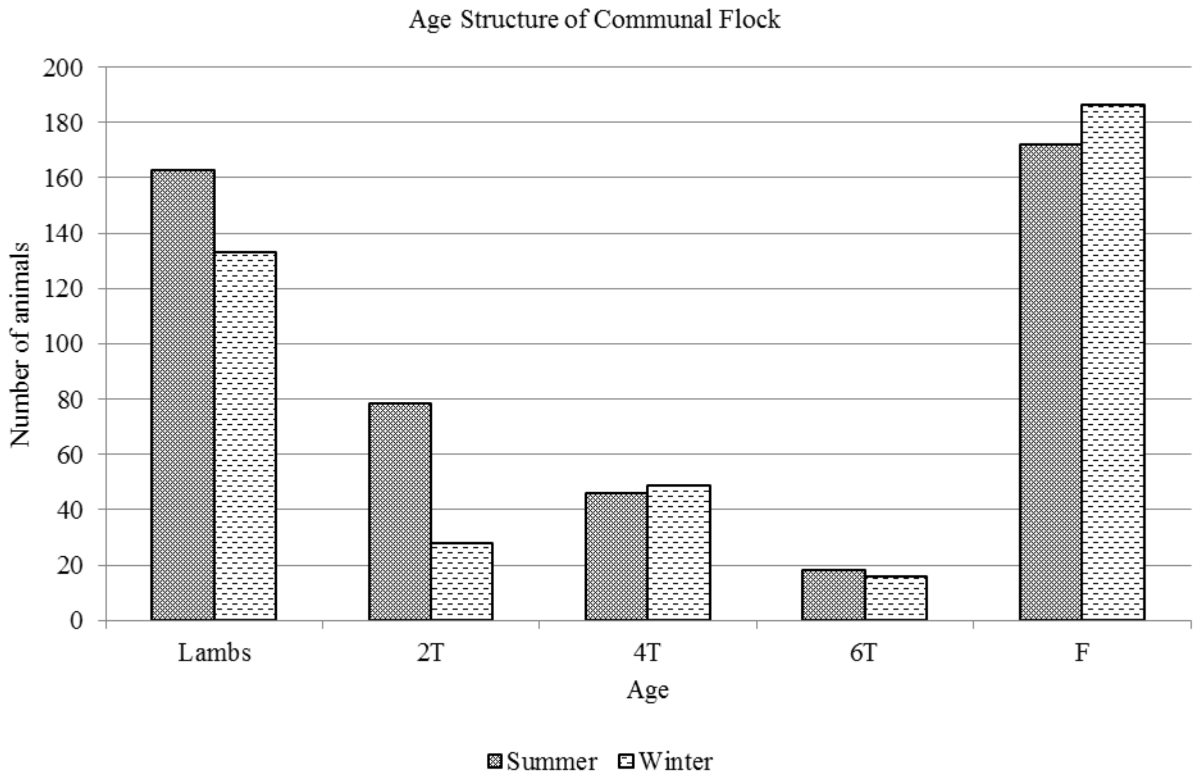

Figure 2 The age structure of the communal flock in during summer and winter recordings

The number of ewe age groups expressed as a proportion of the total ewe flock is given in Table 2. From Table 2 it is clear that there is a decline in numbers in the 4T and 6T age groups. In an open season mating flock, where no selection takes place, the expectation is that the number of animals in the 2T, 4T and 6T age groups should be similar.

Table 2 Percentage represented by different adult ewe age groups as a proportion of the total communal ewe flock

	Percentage (%) of total ewe flock	
Age group	**Summer**	**Winter**
2T	24.9	10.0
4T	14.6	17.5
6T	5.8	5.7
F	54.6	66.7

The lambs were grouped in age groups. The number of lambs for every ewe age group in summer and winter is given in Figure 3. During the summer recording most of the lambs (68%) were between the ages of 1 and 6 months of age.

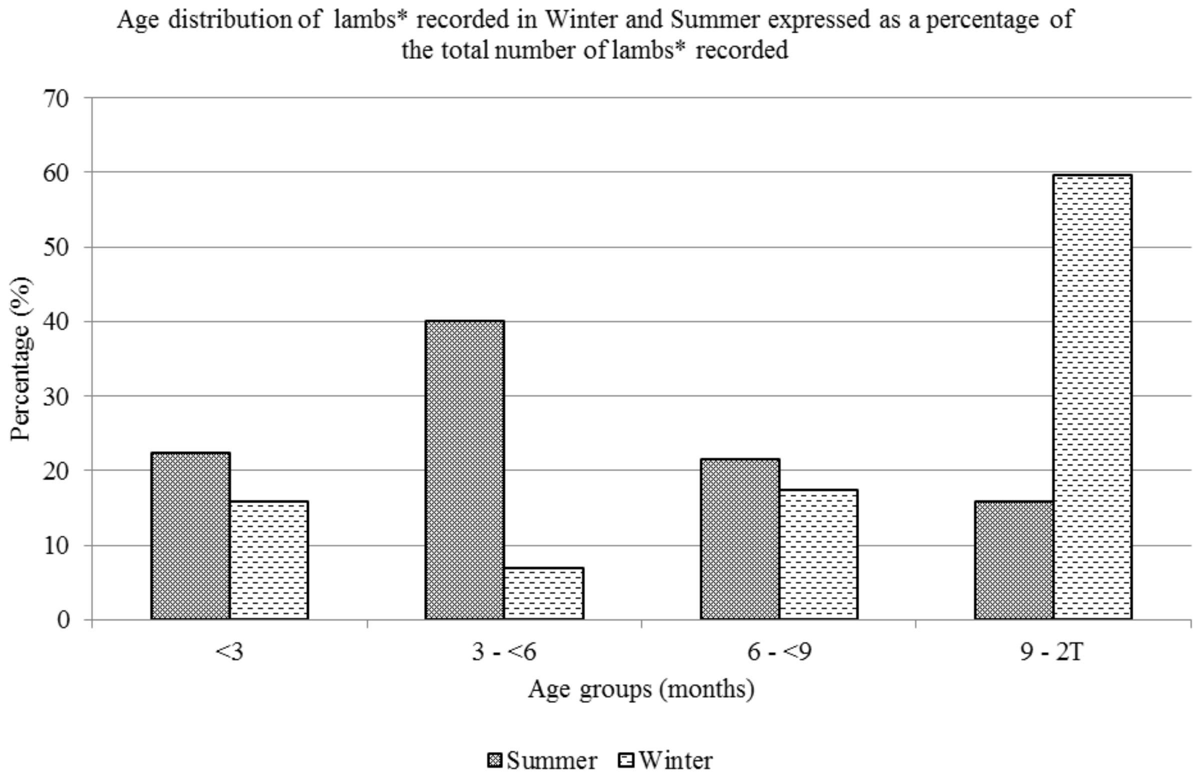

Figure 3 The age distribution of lambs* recorded in summer and winter expressed as a percentage of the total number of lambs recorded
*all young animals with temporary teeth

General statistics of the ewe weights recorded for different age groups in different seasons are given in Table 3. General statistics of the lamb weights recorded for different age groups in different seasons are given in Table 4. The weights of ewes differed significantly ($P<0.05$) between winter and summer recordings. As a group full mouthed and 6T ewes' weights differed significantly from the 2T and 4T ewes during the winter recordings but this trend was not observed during the summer recording. Except for the 0 to 3 month lamb group, other lamb age groups did not differ significantly in weight between summer and winter seasons. Standard errors were small but sample variances were large.

Table 3 General statistics of recorded ewe weights per age group

Ewe age	Summer Weight±SD (Number)	Summer SE	Summer Sample Variance	Winter Weight±SD (Number)	Winter SE	Winter Sample Variance
F	32.6[a] ±4.8 (701)	0.18	23.3	37.0[b] ±5.7 (373)	0.29	32.1
6T	32.6[a] ±5.2 (123)	0.47	27.3	39.2[b] ±5.0 (32)	0.88	24.8
4T	31.3[a] ±4.7 (201)	0.33	21.9	34.3[c] ±5.0 (98)	0.51	25.1
2T	31.1[a] ±4.6 (334)	0.25	21.4	34.0[c] ±5.2 (56)	0.70	26.7

* Values in rows and columns with different superscripts differ significantly (P<0.05)

Table 4 General statistics of recorded lamb* weights per age group

Lamb* age (months)	Summer Weight±SD (Number)	Summer SE	Summer Sample Variance	Winter Weight±SD (Number)	Winter SE	Winter Sample Variance
<3	8.8[a] ±2.3 (189)	0.16	5.1	4.7[b] ±1.6 (55)	0.21	2.5
3 - <6	15.4[c] ±2.1 (336)	0.11	4.4	16.2[c] ±1.8 (24)	0.37	3.3
6 - <9	21.1[d] ±2.3 (181)	0.17	5.3	21.2[d] ± 1.4 (25)	1.7	2.9
9 - 2T	28.1[e] ±4.4 (133)	0.38	19.1	27.5[e] ±3.6 (204)	0.25	13.1

* all young animals with temporary teeth
** Values in rows and columns with different superscripts differ significantly (P<0.05)

A summary of a stepwise regression for recorded weights are given in Table 5. The stepwise regression analysis indicates that within an age group the season affected the weight of the animals more significantly than the year of measurement.

Table 5 Summary of Stepwise Regression for weights recorded

Variable	Step +in/-out	Multiple R	Multiple R-square	R-square Change	F - to entr/rem	p-value	Variables included
Age	1	0.64977	0.4222	0.4222	1295.556	0.000	1
Season	2	0.71424	0.51014	0.08794	318.103	0.000	2
Year	3	0.72025	0.51876	0.00862	31.704	0.000	3

The average weight of the lambs recorded in summer over the trial period increased with 1.6 kg per annum (Figure 4). Summer recordings are presented because they were recorded over the full five year trial period.

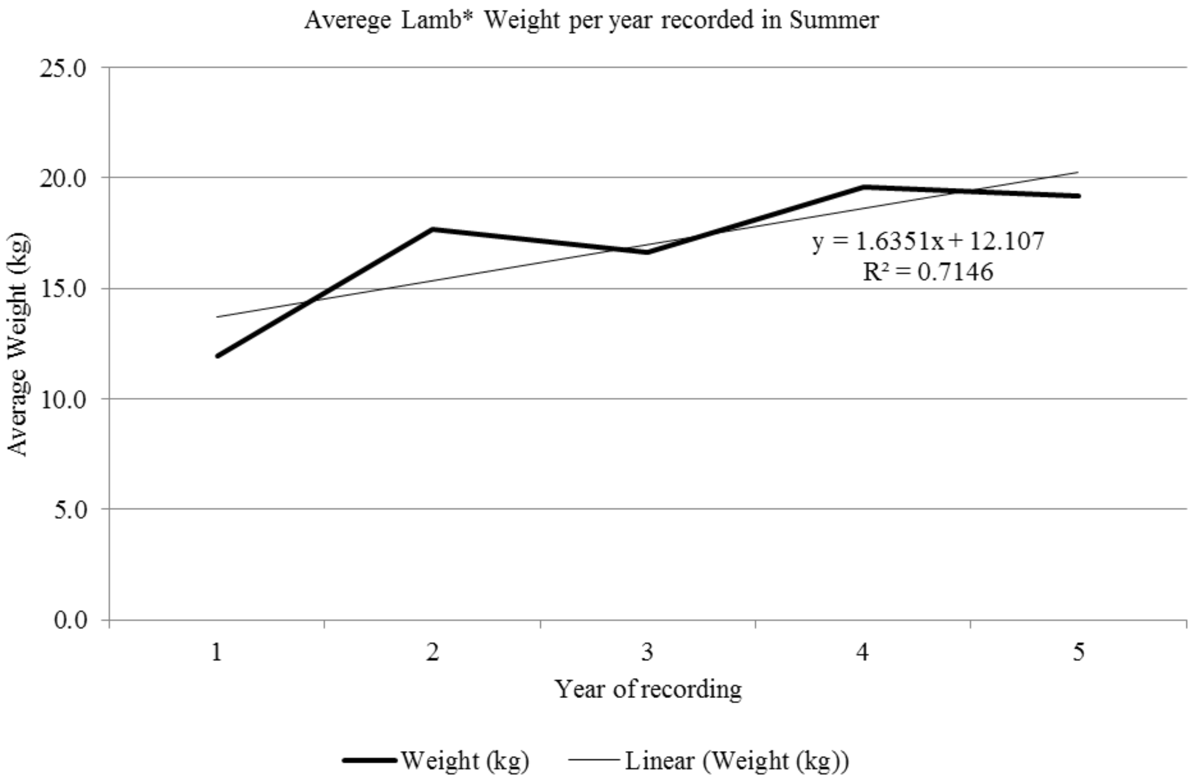

Figure 4 The weight of lambs* recorded in summer over the five year trial period
* all young animals with temporary teeth

The reproductive status of the ewes was determined annually by means of ultrasound pregnancy diagnosis and the pregnancy percentage ranged between 79% and 83% over the five year period.

To try and estimate the impact of the genetically superior rams on the communal flock, an additional year's wool sale information (wool sold on auction in the 13/14 season) was incorporated in the analysis. The net mass wool produced (Figure 5) increased (b = 79.95) and clean yield percentage of the wool improved (b=0.013) over the six year period (Figure 6). When analyzing only the data of the last 3 wool sale years (11/12, 12/13 and 13/14), the improvement on clean yield percentage increased (b= 0.026) after the introduction of genetically superior rams.

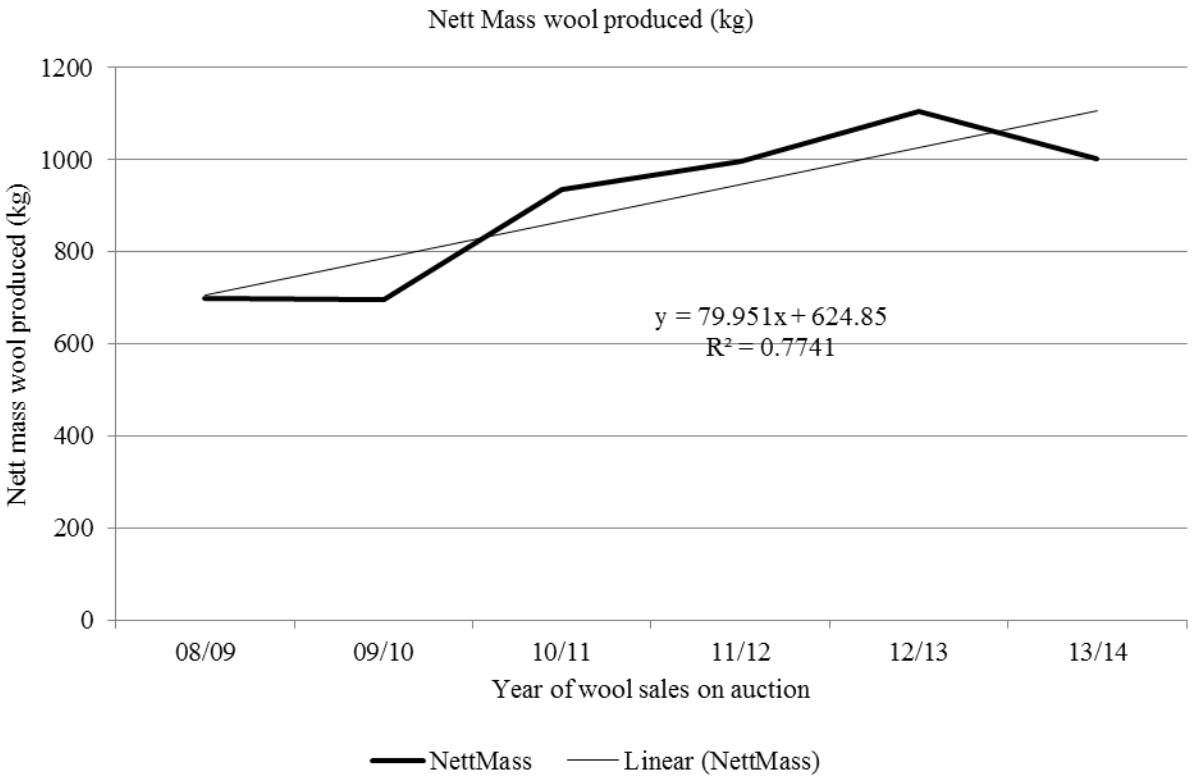

Figure 5 Nett mass wool produced per year for the Ngqolowa Community

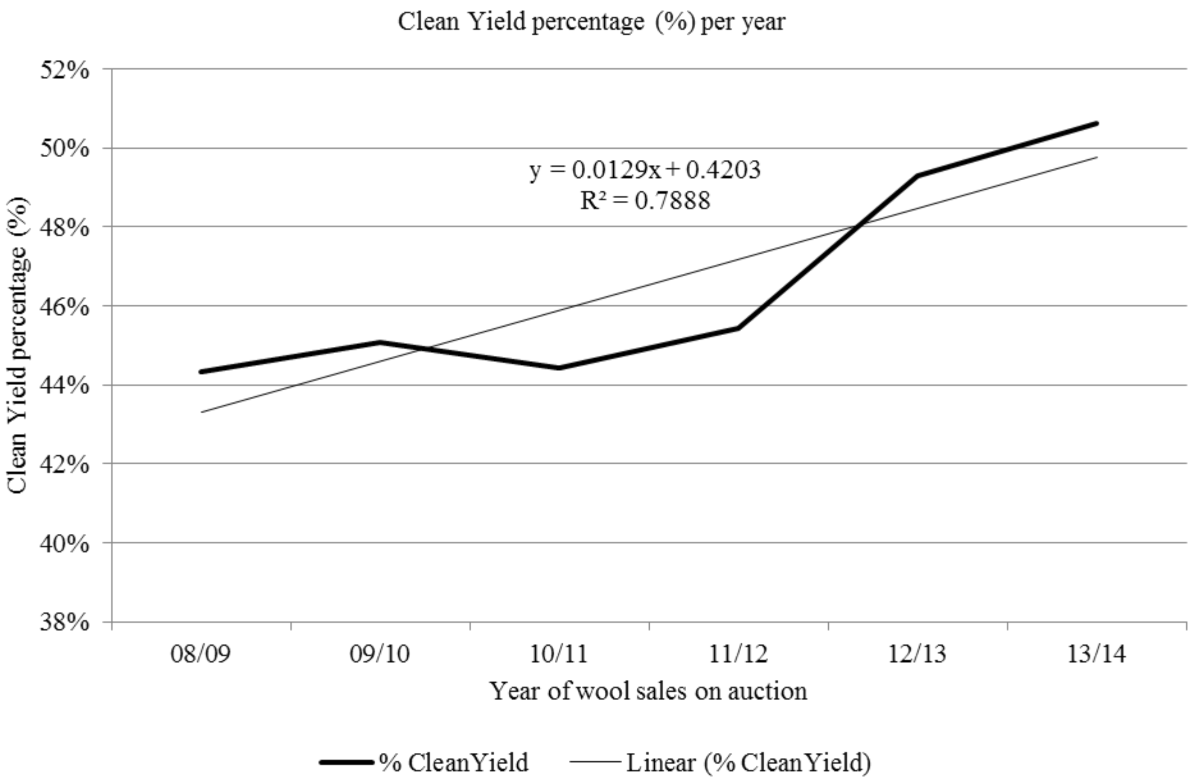

Figure 6 Clean yield percentage per year for the Ngolowa Community

In Year 2 expert practical assistance was given to the farmers during shearing and wool classing. The impact was that the net kilogram wool produced between Year 1 and Year 2 was similar (699kg *vs*. 694kg), but the income from wool more than doubled (R6 576.20 *vs*. R14 040.45). To quantify the improvement in wool quality over the research period, the value per kilogram clean wool was expressed as a ratio of the market indicator. This was done to nullify the effect of wool price increases over time. The percentage earned increased from 42.3% to 55.1% (*b*=0.03) (Figure 7) of the market indicator, indicating that the farmers earned more rand per kilogram wool produced at the end of the research period. Because of the direct intervention of the wool classer in year two, the farmers earned 67.6% of the market indicator. For this reason year two was excluded in the regression analysis for the market indicator ratio in Figure 5.

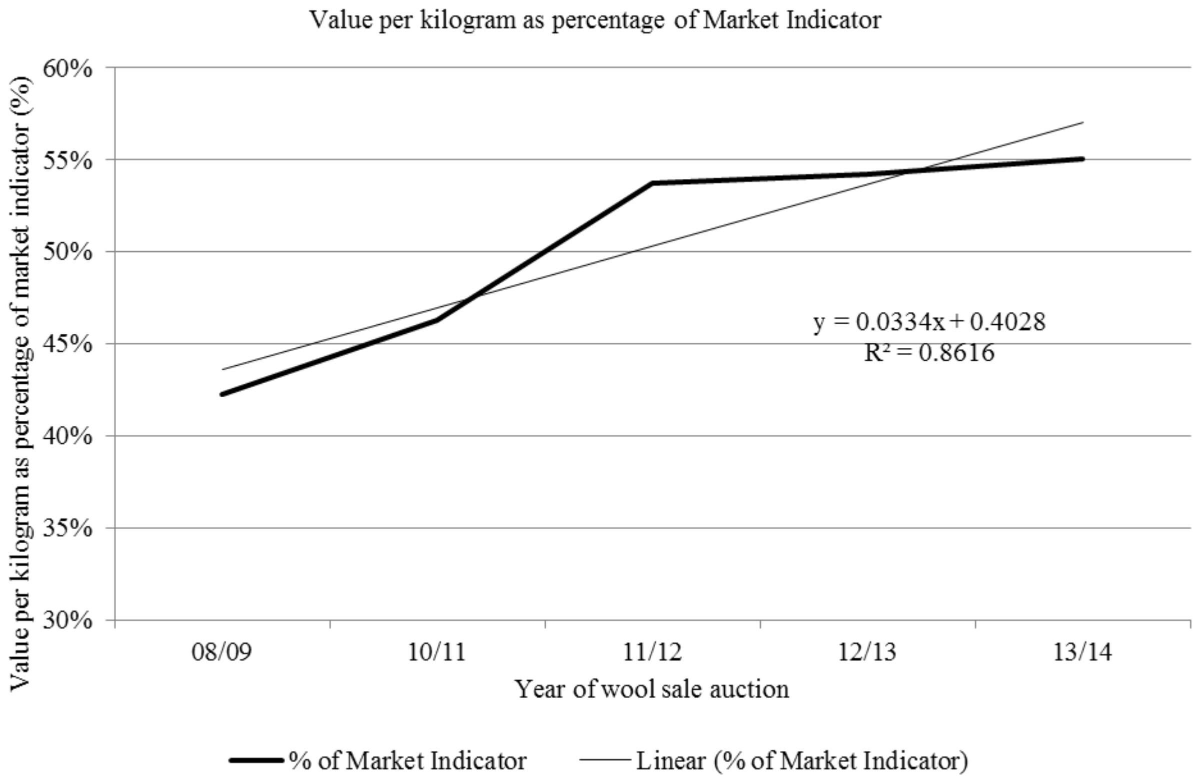

Figure 7 Value per kilogram produced per year expressed as a ratio of the market indicator.

Discussion

The veld survey indicated that the natural rangelands at Ngqolowa are degraded and transformed. This potentially had a significant impact on the current carrying capacity of the farming area. About 36 % of the area has been degraded due to the conversion of pastures to crops and the subsequent abandonment later. Based on veld surveys the area is capable to sustain 451 LSU. From the initial consultation meeting the farmers indicated that in addition to the estimated 400 cattle they keep, they estimated that they keep 400 sheep and 800 goats. The deduction must be that over grazing is a problem for this community.

It must be noted that the measurements and observations were recorded in a communal environment under semi-controlled conditions. The farmers have complete authority regarding the management of their own animals. Farmers were not prescribed to, and continued for the duration of the study, to follow their own preferred management system. None of the animals in the communal flock were identified and the weight measurements over the five years are not replications, but measurements of the presented population at each weighing. Exact measurements and observations in such circumstances are difficult to obtain. Many of the conclusions made are based on probabilities.

The number of sheep owned by each family group varies and 50% of farmers own on average 20 sheep and 24% less than 10. This indicates that the nature of farming for most of the communal farmers participating in the study is subsistence level farming in order to support their household. This is in agreement with Bembridge (1984) that found that 76% of farmers owned less than 20 and 50% less than 10 sheep in the communal farming system.

At the initial consultation visit farmers indicated that most of the ewes annually lamb during June. From the study it seems plausible that the lambing commences from as early as the latter part of April and continues to the end of July. This is deducted from the fact that at the time of the summer recording 68% of lambs were between 3 and 9 months old. Furthermore, 30% of ewes were 3 to 4 months into their gestation at the time of the March ultrasound pregnancy diagnosis. Looking at the lamb numbers in the light of the pregnancy percentages recorded over the five year period, it is estimated that the number of lambs born annually should be high and be more or less 80% of the total ewe numbers. Howerer, the recorded lamb numbers are much lower when pregnancy rates are considered and are only 60 to 65% of what is expected. An estimation of the mortality of lambs from birth to one year of age is thus between 35 and 40%. This corresponds with the findings of Bembridge (1984) and Steyn (1982) that found high lamb mortalities (30.2% and 33.9%, respectively), in the communal farming system.

Lambing occurred just before and during winter. The most likely explanation is that ewes lose condition rapidly as a result of lactating during winter. It is only when the grazing has recovered after the first spring rains that the ewes have the ability to recover to such an extent that they will conceive. From the results from the reproductive status of the ewes, the lambing percentages are estimated as high as 80% and the resulting strain on the ewes during the winter months are catastrophic, with the result that the winter lambing production cycle is maintained.

When looking of the age distribution of the ewes, it is clear that the numbers of young ewes decline. In an open mating season flock, where no selection takes place, the expectation is that the number of animals in the 2T, 4T and 6T age groups should be similar. The decline in numbers are probably due to the fact that after the first lambing and lactation cycle young ewes find it difficult to recover and probably die in the next winter season.

The weights of ewes differed significantly ($P<0.05$) between winter and summer recordings. The sheep were heavier during the winter recordings. The reason for this is probably that the ewes were pregnant at the time of recording and ewes were in a better condition after the summer months. Standard errors were small but sample variances were large indicating large weight and body size differences recorded for the different age groups.

During winter the weights of the 2T and 4T ewes were significantly ($P<0.05$) lower than that of the 6T and F age groups. This trend was not observed during the summer recording. This observation further supports the deduction that 2T and 4T ewes struggle to recover after the first lambing and lactation cycle. A summary of stepwise regression for recorded weights indicates that within an age group the season affected the weight of the animals more significantly than the year of measurement.

Except for the 0 to 3 month lamb group, other lamb age groups did not differ significantly ($P<0.05$) in weight between summer and winter recordings. The average weight of the lambs recorded increased over the trial period with 1.6 kg per annum (Figure 3). The same trend was not observed for the 2T ewes. A possible explanation for this is the introduction of genetically superior rams into the flock from the onset of year three of the trial.

After the first year the net kilogram wool produced in Year 2 was similar but the income of the clip more than doubled. This is probably due to the wool handling and classing training and classing assistance given in Year 2. This indicates that specified training by industry experts can have a large impact on the income from wool. In the third year the standard of classing dropped when farmers where left to perform on their own, but the value of the wool over the remaining years increased, indicating that the training had an impact on the improvement of the value of the wool.

Over the six years net mass wool produced increased by an average of 80 kg per annum. The clean yield percentage of the wool improved with 1.3% per year. To quantify the increase in wool quality over the six year period, the clean wool value per kilograms was expressed as a ratio of the market indicator on the day the wool was sold at auction. When expressing the value per kilogram clean wool as a ratio of the market indicator, the percentage increased from 42.3% to 55.1% (b=0.03) indicating that the farmers earned more rand per kilogram wool produced at the end of the research period. This suggest that the quality of the wool sold improved over the six year period.

Conclusions

There are two critical survival phases in the lifetime of communal wool animals. The first is lamb survival from birth. Estimated pregnancy rate is 80% however recorded lamb numbers are much lower at 60 to 65% of what is expected. An estimation of the mortality of lambs from birth to one year of age during the study period was between 35 and 40%.

The second critical survival phase is for female animals to survive the first lambing and lactation cycle. Most ewes lamb just before or during winter when resources are scarce. The most likely explanation is that the ewes lactate during the winter and spring and they rapidly lose condition due to the poor grazing environment. It is only when the resources are abundant after spring rains that they have the ability to recover to such an extent that they will conceive. The farmers are aware of the advantages of changing the lambing season, but because there are no camps to keep rams separate it is not feasible. Furthermore, it is debatable if the ewes will conceive and maintain a pregnancy during the harsh winter environment.

Most farmers have small numbers of sheep indicating a tendency towards low level subsistence farming that is supplementary to sustain the household. There are large weight and body size variances between animals in an age group.

Training plays a vital role in the improvement of the production level of the flock, notably so with regards to wool handling and classing. Improved classing practices should improve wool earning to a great extent.

The introduction of genetically superior rams seems to have improved the weight of the lambs born as well as the quality of the wool.

It is clear that the farmers overgraze the grazing resource. Extensive restoration of old lands and improvement of veld management practices are needed to improve the productivity of the communal farming area.

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