Sheep flock structure, dynamics, management practices, and wool production under bush encroached and non-encroached areas of the Eastern Cape Province, South Africa

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DECLARATION

I, Lubabalo Kom, declare that this study is an outcome of my own investigation under the supervision of Professor J.F. Mupangwa and has not been submitted to any other University. All assistance towards the production of this work and all references contained herein have been duly accredited.

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ABSTRACT

The main objective of the study was to investigate sheep productivity under bush encroached and non-encroached areas. The study was conducted in two communal areas, namely Idutywa (Mbewuleni village), which represented an open grassland with no encroaching woody species, and Alice (Sheshegu village) which was a bush encroached site. The purposive sampling method was used to select farmers with wool producing sheep who participated in the study. Experiment one employed a structured questionnaire to collect data on sheep flock composition, dynamics and management practices. A total number of 147 respondents were interviewed (73 in Mbewuleni village and 74 in Sheshegu village). The surveys revealed that just above three quarters of the households were male headed with close to half of the respondents being pensioners.

Extensive farming was the production system employed across the two villages with community grazing as their source of feed. The sheep were allowed to graze separately during the grazing period with no other livestock such as cattle. The farmers experienced feed shortage, especially in the winter months and they prioritized feeding their lambs and ewes during this period. Shearing was done once a year in September or October. In both villages there was no controlled breeding and the lambing occurred during the winter period. It was found that the non-encroached site (Idutywa) had a significantly ($P<0.05$) higher number of sheep with 14% of the households having numbers above 121 sheep, while in Sheshegu about 8% of household above 121sheep. The major causes of mortality across the villages were cold weather, drought, predation and diseases. The interviewed households across the two villages mentioned that they dipped their sheep monthly. In the second study, a sample of 110 non-descript sheep breeds were randomly selected from the two villages (10 of each sex and each age group (which is 2 teeth, 4 teeth and 6 teeth) from each village with the exception of the 4 teeth old ewes from Sheshegu). The fleece samples were obtained from the selected sheep in October. The quantity and quality were determine based on wool weight, fibre diameter, colour, staple length, and clean wool. The results of the data analysis showed that the site had a statistically significant (P<0.05) difference on wool quantity between Sheshegu and Mbewuleni villages (2.8164kg and 1.6940kg), whilst the difference based on sheep sex was not significant (P>0.05), respectively. The older sheep produced significantly (P<0.05) higher amounts of wool compared to the younger animals. Wool quality was shown to be affected by locality in all parameters except for comfort factor. The clean yield effects were observed to be particularly more significant (P<0.05) when it came to the clean yield with Sheshegu sheep producing greater clean yield than their Mbewuleni counterparts. There was a significant (P<0.05) differences in the interaction of village and sex for crimp length (males had higher values) whereas that of village and age did not affect (P>0.05) the yield and crimp length. It was concluded from this study that age, sex and weight are the factors that affected wool production (quantity and quality). However, differences were not statistically significant (P>0.05) for effects of sex on wool quantity. Wool quality on the other hand was shown to be dependent on locality across all parameters with the exception of the comfort factor. Clean yield was higher in encroached as compared to non-encroached site. The conclusions from the study were that locality affected sheep flock structure and dynamics, because the encroached site had fewer numbers of sheep compared to the non-encroached site. In addition, the quantity and quality of wool produced differed with site, encroached site values being significantly different (P<0.05) to that from the non-encroached site.

KEY WORDS: Bush encroachment, Wool production (quantity and quality), sheep Dynamics, management practices, and communal areas.

DEDICATION

I dedicate this work to my grandfather July Khalane Kom and my grandmother N.P Maqubela and my lovely mother Khululwa Cyntheria Kom, my father Saziso Kom and also to my three brothers and lovely sister Camagu

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CHAPTER 1: INTRODUCTION

1.1 Background

It is a worldwide observation that rangelands are dominated by a phenomenon known as bush encroachment (Ward, 2005). Bush encroachment can be defined as a natural phenomenon that results in the transformation of a grass-dominated ecosystem to a tree-dominated ecosystem through a process known as plant succession (Ward, 2005). Bush encroachment is a problem in the Eastern Cape Province and has negative implications on wool productivity among smallholder farmers. In his study Ward, (2005) further defined bush encroachment as the suppression of palatable grasses and herbs by encroaching woody species often unpalatable to domestic livestock.

It is alleged that bush encroachment is a result of reduced competitive capacity of grasses subjected to grazing, while Botkin and Keller (1995) says open grassland is described as land dominated by grasses rather than large shrubs or trees. Open grassland is generally fairly flat (Botkin and Keller, 1995). As far as the environment is concerned, wool production is often proficient in different production conditions, although in some areas it is threatened by bush encroachment or desertification (Braker *et al.*, 2002). Producers of wool vary from sophisticated commercial to communal subsistence producers. Sheep farming is widespread in the rural areas of the former Transkei in the Eastern Cape Province of South Africa (Haese *et al.*, 2004).

Sheep farming plays an important role in South African agriculture and makes a major contribution in terms of animal fibre and meat. Wool production is one of the most important activities from sheep farming in South Africa. The South African wool industry provides a high-quality, environmentally-sound product which meets the needs of the textile industry (Cape Wools SA, 2007). On-farm classing and clip preparation for greasy wool is of a high standard and is considered one of the many tangible assets of the industry. South African wool has over the years, earned a reputation for uniformity, softness to the touch and other quality features (DAS, 2009). First-stage processing in South Africa is modern and technologically sophisticated and provides the wool spinning industry with quality input materials to meet the most stringent requirements of the downstream textile processing sector (DAS, 2009).

Sheep flock productivity levels in the communal areas are poorly understood. Sheep off-take, sheep production potential and production efficiency are used as flock production evaluation tools. Sheep off-take, defined as the number of animals marketed and/or slaughtered per given time as a percentage of total flock size (Mapiye *et al.*, 2009) and it is the most common measure of flock productivity. Production potential in communal areas is the proportion of mature and growing animals in the flock (Mapiye *et al.*, 2009). Production potential therefore, reflects the number of potentially saleable or consumable animals in a given system. Production efficiency refers to the proportion of mature animals sold and/or consumed as a fraction of the production potential (Mapiliyao, 2010).

Currently, ways of improving communal sheep production efficiency are restricted by insufficient knowledge on flock dynamics and associated environmental processes (Ainslie *et al.*, 2002). Sheep flock dynamics is a product of changes in reproduction, mortality, off-take rates, and the pedo-climatic and socio-economic factors influencing such changes (Mapiye *et al.*, 2009). Understanding of sheep dynamics is therefore, useful in determining production potential and production efficiency. Seasonal variations are a key factor in communal areas where extensive management of sheep is directly linked to the environmental conditions (Angassa and Oba, 2007). Information on the effect of seasonal changes on flock dynamics and management in communal areas is rare, making it difficult to assess the efficiency of communal rangelands utilisation. It also makes it difficult to predict sheep sales and consumption patterns in the arid and semi-arid areas, where crop production has low potential (Mapiliyao, 2010).

Wool production is influenced by the age, sex, body condition, weight of animals, and by reproduction traits of the ewe (Khan *et al*., 2010). Less wool is grown by young animals per unit of feed intake, presumably due to competition for nutrients between follicles and other tissues. Maximum fleece weights in sheep have been observed as from three to five years of age, with variable rates of decline in wool production thereafter (Corbett, 2001). The number of active follicles decreases with age (Corbett, 2001) but there is no clear evidence that the synthetic ability of follicles also decreases.

The reductions in wool growth with age could be related to changing patterns of feed intake and diet selection (Khan *et al*., 2010). Various quality characteristics tend to deteriorate with age, and crimp abnormalities may appear. Rams tend to produce more wool than withers and ewes, due mainly to their greater size and the better feeding given to rams (Corbett, 2001). Differences between withers and ewes, once the effects of reproduction in ewes are allowed for, are probably small. There can be substantial reductions in wool growth rate during both the latter half of pregnancy and early lactation. Overall, reproduction usually reduces annual fleece growth of ewes by 10 to 14%; the greatest reduction being for ewes rearing twins (Corbett, 2001). Increased feed intake can compensate for the effects of pregnancy and lactation on wool growth in low-producing, but not in high-producing sheep (Oddy and Annison, 2000).

Sheep eat a wide variety of pasture species, but prefer plants that are short and green (Geyer, 2007). Wool is produced in almost all the provinces of the country (South Africa) under extensive, semi-extensive or intensive conditions. The carrying capacity of the wool producing areas varies from 5-10 hectares per small stock unit in the more arid areas, to 25 small stock units per hectare on cultivated pastures (Ellery *et al*., 1995). The sheep breed with the highest wool production per head in South Africa is the pure-bred Merino, followed by other dual-purpose Merino strains, of which the Dohne Merino, the South African Mutton Merino and the Letelle are the most popular (Geyer, 2007).

South African sheep farmers collectively produce about 46 million kilograms of wool per year of which 12% is from communal and emerging wool producers (CAPEWOOLS S.A., 2007). The communal and emerging wool producers are mainly located in the former homelands of Transkei and Ciskei (Eastern Cape) and parts of Thaba Nchu and Qwaqwa (Free State), (CAPEWOOLS S.A., 2007). These areas produce just over 4 million kg of wool annually, of which 2.03 million kilograms is marketed through brokers on the formal auction. There are about 846 communal shearing sheds in the Eastern Cape, that vary from old and poor constructions with insufficient equipment, handling facilities and no dipping facilities, (CAPEWOOLS S.A., 2007).

Makapela (2008) stated that management is the most important factor for successful farming. As a result of the diversity of skills required, successful farming makes greater demands on management. Makapela (2008) stresses the fact that the specialist livestock farmer may conduct as a sideline to some other enterprises or as single enterprise livestock farming. Management is a farmer’s understanding on what to do and when to do it. Sanitation, ventilation, breeding, feeding, treatment, close observation and the provision of adequate space for water, feed, rest and exercise, are all important management practices (Stewart, 1995). In accordance to Makapela (2008) sheep farmers have full control over the three most important factors which will enable them to make sheep farming a success namely: flock management, breeding, and production.

1.2 Problem statement

Sheep are affected by several major constraints of production in communal farming areas. Some of these constraints include high disease and parasite prevalence, low levels of management, limited forage availability and poor marketing management. It has been observed that sheep productivity is currently low under village conditions (Mapiye *et al.*, 2009). In addition, bush encroachment poses another challenge to sheep production in resource-poor areas of the Eastern Cape Province of South Africa. Bush encroachment affects wool production both directly and indirectly. Directly by restricting movement of sheep while grazing, breakage of wool by trees while sheep graze between trees. Indirectly by reducing the number of palatable grass species for grazing sheep. Rapid increase in woody population and degradation of grazing resources badly affects sheep production (Mapiliyao *et al*., 2010). Communal area wool production systems are inherently inefficient and productivity is low due to poor management of both stock and rangelands [Cousins (1988) cited by Tinoziva (2001)]. This subsequently leads to diminished farm income (Lukomska *et al.*, 2010). Many studies that have been conducted to evaluate the impact of bush encroachment on the vegetation. However, there is little information concerning the effect of bush encroachment on wool production in communal areas of the Eastern Cape Province where sheep are dominant.

1.3 Justification

The study aims to assess the impact of bush encroachment and management practices on sheep production. This information will discern the main challenges and devise strategies to ensure proper and efficient management strategies. The study will come up with solutions concerning aspects of sheep production such as poor wool quality and quantity and decreasing sheep numbers in the communal areas. The knowledge of the management practices employed in communal areas affords the advantage of being able to assess production rates in a way that allows implementation of interventions in a timely manner. Since most of the resource-poor people in communal areas earn their livelihood directly from livestock farming, any research focusing on improving livestock productivity could therefore result in improved livelihoods.

1.4 Objectives

The main objective of the study is to investigate sheep productivity under bush encroached (Sheshegu village) and non-encroached (Mbewuleni village) areas of the Eastern Cape Province, South Africa.

The specific objectives are to:

i. Determine sheep flock composition and dynamics; and management practices under bush encroached and non-encroached areas.

ii. Determine the influence of animal related factors (sex, age, body condition and weight) on wool production from sheep under bush encroached and non-encroached areas.

1.5 Null hypotheses

i. The flock structure, sheep dynamics and management practices are not affected by bush encroachment in the target communal areas.

ii. The wool quantity and quality in the target communal areas are not affected by animal related factors in the bush encroached and non-encroached areas.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

For most of this century, there has been concern about the state of communally grazed rangelands in Africa and other parts of the world. Management in communal rangelands is poor which may result in degradation and unproductive state (Sullivan and Rohde, 2002) therefore it may lead to decreasing sheep numbers. More recently, this way of viewing communal grazing systems has come under huge criticism concerning its economic and ecological assumptions, and the idea that communal rangelands are certainly degraded is now widely challenged (Sullivan and Rohde, 2002).

The persistent overgrazing as influenced by stocking rate, results in changes in the botanical composition of the veld (Tainton *et al.*, 1999). Sheep are greatly prolific animals, they are under threat of shortage of feed, poor health and poor housing management leading to high lamb death rates (Homman *et al.*, 2007). Some of these constraints can also lead to poor wool production and poor quality of meat, which can impact negatively on the sheep industry (Muchenje *et al.*, 2008). Also constraints such as lack of technical skills, occurrence of predators and rustlers severely affect sheep production in communal areas (Muchenje *et al.*, 2008).

There are several factors which can affect wool production directly or indirectly. Genetic and environmental factors are major factors influencing wool production. Bacterial, viral, fungal and especially parasitic diseases are other factors which are also affecting wool production (Khan *et al*., 2010). Other factors are exogenous chemicals, hormones, weather and photo period. Currently the existing knowledge on the factors affecting wool was reviewed but there are gaps to conduct research on fundamental aspects of wool growth, which could have relevance to other areas of biology (Khan *et al*., 2010).

2.2 Sheep production in communal areas

Livestock is the largest user of farming land for grazing, forage crops and other feed, while it contributes about 40% of the gross value to world agricultural production (Mapiliyao, 2010). The International Institute for Food and Policy Research (IFPRI) in 2011 has foreseen a huge increase in demand for animal products in countries, triggered by population growth, increased urbanisation, higher incomes and increased consumption opportunities for resource-poor farmers to improve their livelihoods. While, there are some challenges and threats looming as well. It is observed that smallholder agriculture is negatively affected by many problems in the Republic of South Africa (Muchenje *et al.*, 2008).

The poor-resource limited farming systems are generally associated with lack of suitable production resources. The most limiting factors faced by the smallholder sheep farmers are climatic stresses, shortage of grazing land, shortage of water, endemic disease and parasites prevalence (Mahanjana and Cronje, 2006). Such a situation leads to food insecurity and leads to poverty in the poor resource communal farmers. Shortage of capital, diversified agriculture and informal labour arrangements derived from family members (De Sherbinin *et al.*, 2008), with some non-agricultural activities to supplement household incomes characterizes the smallholder farming systems of South Africa. Lack of managerial skills as well as general socio-economic characteristics, constitute low production in sheep. Whereas, preferment of use of indigenous breeds that are adaptable to the semi-arid conditions could be one option of empowering the small holder sheep farmers (Mapiye *et al.*, 2009).

In various parts of Africa sheep are a supplementary enterprise to cattle (Karim *et al.*, 1998). They reproduce more quickly than cattle, however they experience greater mortalities. When drought strikes, sheep are generally slaughtered before goats, because they are less hardy, they are likely to display poorer recovery following droughts (Baars, 2000). They are suitable in saltbush environment. Sheep are more salt tolerant than other farm species, with the acceptation of the camel (Baars, 2000). The lack of phosphorus can cause suffering particularly when it is severe and it leads to wrecked bones. Subclinical forms are a particular problem in some parts of the world where subsistence sheep farming are practiced causing economic losses in production particularly when lactation coincides with a late dry period (Karim *et al*., 1998).

Farmers shear their sheep once per year usually in October of every year in most areas in South Africa. It is preferred to shear their sheep in late spring when the weather is warm and sufficient grazing is available (Mvinjelwa *et al*., 2014). The average wool production in communal areas per sheep is 2.17kg. This is far below the wool production of the commercial farmers of the Eastern Cape who are producing between 4kg to 5kg of wool per sheep on average within a growing period of 12 months (Makapela, 2008). The lack of proper fencing and camps causes major reproduction problems. In general, quality of wool produced by communal farmers is not meeting the standards set by the Nation Wool Growers Association of SA (Makapela, 2008).

2.2.1 Sheep population dynamics in communal areas

It is common under village condition that farm animals are poorly managed in South African agricultural systems owing to the fact that the animals are commonly managed on free range/extensive systems and semi-intensive systems (Ahmed and Egwu, 2014). These management practices are mostly influenced by cheap means of feeding the stock all year round. Therefore, livestock are consequently allowed to roam the rangelands to fend for themselves with little or no special or reliable provision of supplements for the animals (Vetter, 2005). Even though, commonly raised farm animals under the free range and semi-intensive systems include the ruminants, sheep and goats constitute the major farm animals largely raised in these systems of livestock management (Ahmed and Egwu, 2014).

Continuing debates in range ecology are that concerning the relative importance of density reliant on interactions and annual rainfall in determining annual herd productivity, reproduction and mortality (Sullivan and Rohde 2002). In grazing practices with very high climatic variability, forage availability varies to such a great degree with rainfall such that livestock population dynamics are driven by rainfall rather than density-dependent interactions such as competition for resources (Vetter, 2005).

The livestock numbers build up during periods of wet years, but mortality is high and independent of livestock density in severe droughts, mostly droughts lasting longer than one year (Oba 2001). Population size hence fluctuates intensely, although it may not track rainfall closely because of the time it takes populations to improve from crashes. In a grazing practice with relatively predictable rainfall and hence forage production, livestock populations are regulated in a density dependent manner through competition for food resources. A sign of density-dependence is that population growth rates decrease with increasing population size because of the effects of competition on reproductive and mortality rates (Oba 2001).

Contrast is an oversimplification of the range of conditions found in the real world. For example, density-dependent dynamics in non-drought years can alternate with density independent mortality during droughts and subsequent recovery (Vetter, 2005). Also, describing livestock population dynamics simply in terms of density-dependence or a lack thereof ignores the underlying mechanisms of the consumer-resource dynamics and how they are affected by seasonal variability and spatial heterogeneity in forage quality and quantity (Owen-Smith 2002).

Studies include a simple analysis to distinguish whether changes in livestock numbers and flock growth in the communal areas are rainfall-driven or density dependent. This is of interest because imbalances in grazing systems, where livestock populations fluctuate with rainfall, are thought to be less prone to grazing-induced degradation than systems where livestock populations are in density-dependent balanced with the vegetation (Behnke and Scoones, 1993). Environments with a rainfall coefficient of variance of more than 33% are hypothesized to experience mostly imbalanced dynamics (Ellis, 1994).

Other studies show that rates of reproduction, mortality and offtake are low by commercial standards and similar to those reported in other studies of communal farming systems in South Africa. Comparison with these other studies is complicated by the fact that all of these authors use mean values when presenting their data on flock size and production coefficients (Mapiliyao, 2010). Mapiliyao (2010) presented the factors affecting flock dynamics by using mean values in the figure below.

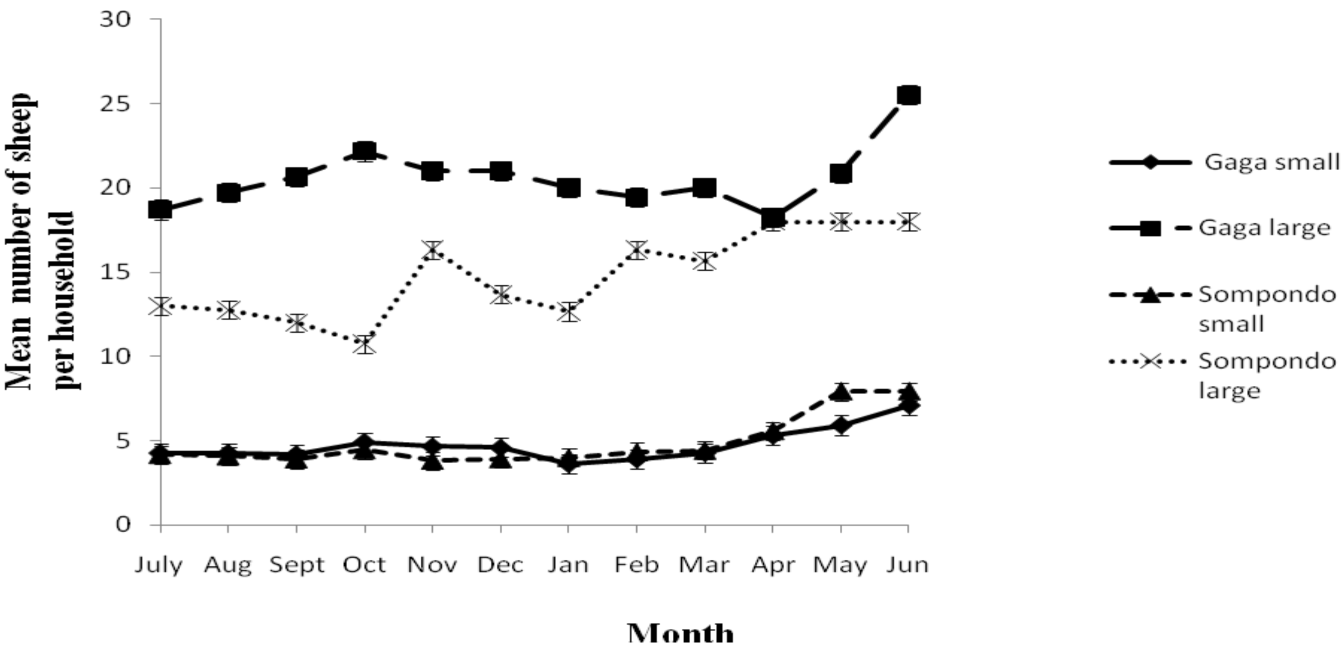

Figure 2.1. Monthly flock dynamics from July 2009 to June 2010 in the small and large flock groups across the two villages (Mapiliyao, 2010).

Flock dynamics in communal areas are affected by several factors such as mortality, slaughtering, birth etc. Figure 2.1 shows monthly flock dynamics from July 2009 to June 2010 in the small and large flock groups across the two villages under Alice region which is

Gaga and Sompondo village. The result that flock entries were affected by month can be credited to the fact that during hot-wet months and cool dry months forage quantity and quality are high (Peacock *et al*., 2005) and agrees with the periods of increased parturitions in the two villages. Abundance of high quality forages during these months can increase chances of survival of lambs. Seasonal trend in rainfall and feed availability had an influence on the number of sheep by affecting mortality rates. This finding agrees with observations by Scoones (1995), Fynn and O'Connor (2000) and Mellink and Martin (2001) cited by Mapiliyao (2010) who reported a curve-linear relationship between rainfall, feed supply and cattle performance in the arid and semi-arid areas.

The high mortality observed as the highest contributor to the total sheep outflows were related to their greater vulnerability to seasonal feeds. The fact that mortality constituted the greatest contributor to outflows is in agreement with findings by Mapiliyao (2010). Mortality was higher during the hot-dry and hot-wet season due to seasonal changes in the quality and availability of feed resources. Differences in mortalities in Sompondo and Gaga could be a result of variation in agro-ecological characteristics of the two areas. The high mortality observed in the hot-wet season can be attributed to warm and moist conditions which promote vector survival and multiplication (Marufu *et al*., 2010). For example, Gallsickness and heartwater diseases which were reported as the main cause of sheep mortality in this study are transmitted by ticks whose rate of proliferation is accelerated when environmental temperatures and humidity are high (Marufu *et al*., 2010).

Peak sales for Sompondo and Gaga took place in April, during the time of Easter celebrations, followed by June the period of food shortage and initiation of the boys. Slaughtering was at the peak in the hot-wet season (December) during the festive season, for sheep sold and consumed and this finding concurs very well with Coetzee *et al*. (2005), Montshwe (2005) and Delali *et al*. (2006) who reported a similar trend in cattle. However, farmers fetched low prices for their sheep during the cool-dry season due to poor body condition, supplementary feeding could be at the core of any strategy to increase sheep off take in the two different communal areas. Alternatively, farmers concentrate on selling their sheep at the end of the post-rainy season when they are still in good condition (Mapiliyao, 2010).

Mapiliayo (2010) observed lamb mortality rates in Sompondo and Gaga were less than five percent rates acceptable under commercial enterprises (Kyriazakis and Whittemore, 2006). The observation that lamb mortality was the major exit from both flock sizes in the two villages was expected. Conditions under communal areas where sheep housing facilities are poor or non-existent expose lambs to vagaries of the weather (Ramasa *et al.,* 2009). Lambs are likely to die from rain, cold weather and predation. In the two ecologically different villages, although these causes were not quantified accurately, the finding that lamb mortality was higher during the rainy season than during the cold and hot seasons indicates that rain, rather than cold weather was the major constraint to lamb survival as observed elsewhere (Ramasa *et al.,* 2009) In the Eastern Cape Province, January is usually the wettest month of the year (Marufu *et al.,* 2010).

2.2.2 Sheep flock composition

Flock composition refers to age and sex profile of the flock, which is the relative number of each age and sex (Ahmed and Egwu, 2014). The flock keeper determines flock structure based on economic and management considerations and implements the plan by practicing appropriate purchasing and sales. Flock composition is influenced by death rate and reproductive performance (Mapiye *et al*., 2009). Generally flock keepers practice a broad objective for a certain flock structure and then follow some adjustments in response to market fluctuations and year to year variation in reproductive performance. Optimization of the flock structure is one of the most influential strategies which producers have to maximize profitability (Ahmed and Egwu, 2014).

Flock composition data in Herschel were similar to findings in other South African communal areas, like KwaZulu Natal (Tapson and Rose 1984), and the Amatola Basin in Ciskei (Steyn, 1982). The organization into age and sex groups differed between studies, and as a result direct comparisons were difficult. All of these studies found percentages of ewes and lambs to be lower than in "ideal" commercial systems, which have around 50% mature ewes according to Steyn (1982). Percentages of old and male sheep are higher in communal systems, indicating lower productivity and less offtake. The low offtake rates must however be seen in the light of the small average flock size such as 1-30 sheep (Mapiliyao, 2010), a factor which widely held to inhibit offtake in communal areas (Vetter, 2005).

2.3 Management of sheep

Management practices (health program, feeding, breeding, and housing) are necessary in any sheep farming enterprise to prevent disease and production losses. Some methods can result in a short period of distress but then again the consequences of not performing them may cause far more pain and distress to the animal than the technique itself, once it is done at the right time and expertly (Makapela, 2008). The practices that may lead to pain should be applied in such a way as to reduce pain and should not be carried out if practical replacements can be used to accomplish the same results. Skilled persons should do management techniques carried out on sheep and the related hygiene protections should be undertaken (Makapela, 2008).

2.3.1 Feeding

Sheep should have access to good feeding which is nutritionally suitable to sustain health and meet the correct physiological requirements for pregnancy, growth, fertility, lactation and to withstand cold exposure (Sundquist, 2003). In any systems of management, persistent assessment should be made of the needs of the sheep in relation to the amount, quality and continuity of feed supply. In case of full feeding, diets should be formulated by a professional animal nutritionist to prevent metabolic disorders and accompanied unnecessary discomfort, pain and deaths (Sundquist, 2003). Sheep should be excluded, as far as possible, from toxic plants and other substances suspected of being deleterious to their health. Feed must be of good quality and free of poisonous plants and seeds (Makapela, 2008). The use of animal by-products must be avoided.

Sheep in communal areas of South Africa mainly graze on natural pastures, where the supply and quality of pastures changes seasonally (Lesoli, 2008). The rangeland is degraded due to high and increasing human and livestock populations as well as poor land use policy resulting in low productivity of the system (Lesoli, 2008). Over utilized grazing areas, soil and organic matter burning and soil erosion are all major concerns (Lesoli, 2008). Insufficient access to feed impacts the sternness of several infections, mostly in young sheep (MacRea *et al.*, 1993). The integrated combined efforts of improving land tenure policies to encourage natural resource management, sheep productivity through reducing stressors (for example: drought, bad weather conditions, and diseases) by flock health management, genetic means (for example: within and between breeding program), and improving productivity per unit of input is of vital importance (Stewart, 1995) cited by Makapela (2008).

The key factor in increasing fertility in sheep flocks is good feeding (supplementation, flushing) and well throughout strategized management practices before introducing teaser rams and during the breeding season, late pregnancy and lactation (Sundquist, 2003). Stage of reproduction are affected by feeding, from puberty to sexual maturity, the production of eggs and sperm, higher sexual activity, beginning and extension of breeding season and lactation (Sundquist, 2003). Insufficient feeding during the above mentioned critical production phases result in sheep productivity and as a result to fewer sheep available for selection and surplus marketing. Reproduction is the major important economic factor in sheep farming (Steyn, 1999). It is a resolution of deliberate management action and the use of farming practices that impact productiveness (Steyn, 1999).

The nutrient requirements and feed utilization of sheep at different physiological status is variable. The animals need to be fed according to their needs in order for them to produce and reproduce effectively. Sheep require water, protein, minerals, vitamins, and energy to sustain life. Nutrients are required for growth, maintenance, gestation and fattening (Gipson *et al.,* 2005). Feeding depends on the breed and individual growth rate. Rams should be in moderate body condition score going into the breeding season. Adult males can be maintained on good pasture alone when not used for breeding. Adult males used for breeding should be well fed to maintain their body condition score for maintenance of vigour for mating (Gipson *et al.,* 2005). A body condition score of 3 to 3.5 before the beginning of the breeding season is required. About 12% of their weight can be lost during a 45-day breeding period. Breeding rams should have their weight maintained to avoid being too fat (Karim *et al*., 1998).

Dry breeding females need nutritional feeds to maintain desired body weight since no form of production is occurring. These animals can be maintained on good quality pasture or fed good quality hay depending on physical condition at weaning. Very thin animals adversely affected by the stress of lactation need supplementation in addition to forage for adequate preparation for the next breeding and conception (Karim *et al*., 1998). However, for preparation of female sheep for breeding. Flushing is the practice of feeding the ewe supplementary energy or protein about two weeks before breeding and continuing at least 2 to 4 weeks into the breeding period (Gipson *et al.,* 2005). Flushing puts females in a positive energy balance and results in weight gain. Flushing can improve fertility and increase implantation of fetuses in the uterus with the overall result of increased multiple births (Gipson *et al.,* 2005). Too much feed causes animals to fatten which could lead to difficulties in breeding. It is advisable not to flush ewes with a body condition score of 3.5 or more. Flushing works best with thin animals (Gipson *et al.,* 2005).

Young animals selected for breeding need extra feed for growth so that they will be large enough and in good shape for breeding. They should be fed grass/crop residues free choice and Supplementary legumes, up to 1 part for every 3 parts of grass/crop residues consumed. Pregnant females also need nutrients support the growth of the foetus (Karim *et al*., 1998). However, they should not be fed to become too fat. Females that are too fat will have trouble lambing. During the gestation period animals should have grass/crop residues free choice. Females in late pregnancy (2-3 weeks before the lambing date) are in a period by far the most critical during which correct feeding is important as the foetus grows fastest at this stage of development (Karim *et al*., 1998). The ewes in this stage should receive a free access to good quality pasture and other roughage. Lactating animals requirement are similar to those of late pregnancy and their rations should generally contain 14-16 % crude protein. They have high requirements for milk production (Karim *et al*., 1998).

In sheep production, new born lambs should be supplied with colostrum within the first hour after birth. Colostrum helps to protect them against diseases due to its content of antibodies and high nutritional value. For the first few weeks of life, all a lamb needs for nourishment is its mothers milk. Water, hay and protein supplements should be placed near the lambs so that they start to eat and drink as early as possible. Young ones can begin to consume other feeds at about six weeks of age (Gipson *et al.,* 2005). They should be fed the best quality feeds available to help them grow and get them accustomed to eating feeds other than milk. The feed needs to be of high quality because they can eat only small amounts. They should receive high quality young forage, free choice consisting of supplementary legumes as much as available and free choice supply of concentrates. The concentrates should be fed in creep feeders so that only the lambs can consume it. This prevents the adult animals from eating the feed intended for the young animals (Gipson *et al.,* 2005).

Weaning involves removing young ones from the milk diet to other forms of feed. This separation can be stressful. Lambs are very vulnerable to disease and growth depression at the time of weaning unless they are weaned on high quality feeds (Karim *et al*., 1998). Weaning at two to three months of age depending upon management is possible. Abrupt weaning is unnatural and should be avoided. Ideally, weaned lambs should receive high quality young forage, free choice and free choice supplementary legumes. They can be started with 70g/day of mixed concentrate or 150g wheat bran, and the amount can be increased as they grow (Karim *et al*., 1998).

2.3.2 Sheep feeding and animal weight

A good feeding (good quality pastures, flushing, growing condition of ewes in rested sites) is the main aspect in increasing fertility in sheep flocks (90%), and well strategic management practices before using teaser rams and during the breeding season, late pregnancy and lactation. Feeding affects all phases of reproduction, from puberty to sexual maturity, the production of eggs and sperm, higher sexual activity, start and extension of breeding season and wool production (quantity and quality). Insufficient feeding during the abovementioned critical production phases results in poor productivity, lower conception percentages, lower lambing percentages, higher lamb mortality, lower weaning percentage, lower weaning weights, poor growth and development of young sheep and therefore fewer animals available for selection and surplus marketing. Reproduction is the most essential economic factor in sheep farming. It is a function of deliberate management action and the application of farming practices that affect fertility (Makapela, 2008).

2.3.3 Water

Sheep should be allowed access to good quality water. Regular assessment should be made of the quality and quantity of water source with attention to the special needs of lactating sheep, feedlot lambs and sheep in hot weather (Steyn, 1999). The watering points should be of adequate capacity and allow safe access. The mechanical equipment controlling the delivery of water (including dams, rivers, windmills and boreholes) should be inspected regularly, and frequently in hot weather conditions, and kept in worthy working order (Lesoli, 2008). The quality of water provided should be adequate to maintain sheep health. The voluntary water consumption of adult sheep is 2 or 3 times dry matter consumption and it increases with high-protein and salt-containing diet (Lesoli, 2008). Drinking of water which contains potentially toxic levels of salts, or other harmful substances should be supervised and managed to reduce dangerous effects. Wherever adequate good quality water to maintain health cannot be provided, the sheep should be moved to other areas where an adequate supply is available. As a guide, sheep should not be deprived of water for more than 24 hours. This period should be reduced in the event of hot weather (Steyn, 1999).

2.3.4 Diseases

Sheep industry growth in different countries is affected by diseases (Devendra *et al*., 2000). The animal health problems are barriers to trade in sheep and their products, while specific diseases reduce production and promote morbidity and mortality (Bebe *et al*., 2003). Sheep diseases are a problem since the sheep of resource-poor farmers are mostly susceptible to diseases because of the lack of capital inputs and medicines. The most common diseases which results in problems are Anaplasmosis, Heartwater, Anthrax, Foot and Mouth, Black-leg, Contagious Abortion and Dystocia. Moreover, movement of sheep and their by-products such as wool are problematic to monitor in the rural regions (Musemwa *et al*., 2008). Sheep diseases have multiple impacts. The epidemic diseases limit trade in sheep and their products. The occurrence of such diseases impacts both poor and rich sheep producers by downgrading them from high-price sheep markets and limiting their ability for value-added trade (Devendra *et al*., 2000). Diseases result in poor wool quality, poor productivity, reduced lambing rates, increased lamb mortalities, decreased sheep off-take, increased veterinary care which are expensive, decreased flock size and decreased sheep efficiency (Rumosa e*t al*., 2009).

2.3.5 Dipping

Dipping is the most important management practice used to control tick load. It is advisable that sheep should be dipped for lice 2–6 weeks after shearing to allow time for shearing cuts to heal (Devendra *et al*., 2000). Dipping after 6 weeks may not be fully effective as the dip wash cannot penetrate through fleece down to the skin (Bebe *et al*., 2003). For best results, it is advisable to dip sheep that are clean shorn with no remaining tufts of wool and dermatophilosis free or free from other skin problems. For fly control, sheep should be dipped 4–6 weeks off-shears to allow adequate wool growth to retain the chemical. Dipping must result in the complete wetting of sheep so the chemical can penetrate to the skin (Musemwa *et al*., 2008).

2.3.6 Housing

Sheep require shelter from the extremes of weather to reduce mortality. This may be as simple as a shelterbelt tree plantation, or a windbreak. Where a building is used to supply shelter, it should be planned and sustained to provide clean, well-ventilated and sanitary conditions (Stewart, 1995). Adequate ventilation should be provided when animals are housed indoors to reduce the risk of pneumonia and the chilling of lambs. Sheep should have access to a well-drained area for rest and rumination (Musemwa *et al*., 2008).

The Inappropriate hygienic housing results to higher prevalence of parasites and diseases which reduce sheep productivity (Mogashoa, 2015). Mogashoa (2015) perceived that the extensive production system entails considerable hazards to the sheep due to lack of housing. The establishment of good housing can improve the sheep productivity by giving protection from extreme weather and predators.

Mogashoa (2015) observed that Poor housing condition was observed across Nkangala district municipalities. Mapiliyao et al. (2012) reported similar observation of poorly constructed sheep houses in Gaga and Sompondo communal villages. According to Mapiliyao (2010), extensive farming system has a high risk to diseases, predation and theft. Sheep needs appropriate housing which can keep them from extreme temperatures and predation. Extensive production system entails considerable hazards to animals due to lack of housing, no basic care and unavailability of records.

2.4 Live weight of sheep

Throughout the production cycle, sheep producers in communal areas must be able to know the status of their sheep by using physical examination. There is required weight on different stages of production. Live weight at a given phase of production is the best indicator, however there is a varied difference in developed size between individuals and breeds. It is extremely difficult to use weight to define an appropriate body condition. Body condition scoring is used designates the condition of a sheep, is appropriate, and is much more precise than a simple eye assessment. The Determination of health and nutritional state of livestock using body weights and condition have been reviewed by many authors (Mapiliyao, 2010). A body condition score evaluates the condition of muscling and fat growth.

Russel, (1991) cited by Mapiliyao, (2010), observed that body scoring is grounded on feeling the level of muscling and fat deposition over and around the vertebrae in the loin region. Resource-poor farmers do not have scales for weighing their sheep; it is of necessity that research should focus on the compatibility of condition scoring as a health and/or nutritional status indicator in the communal sheep. The Ecological variances entails rainfall and temperature variances which plays a major role in changeability in body weight and condition at different months. Seasonal variation is a key factor in communal areas where extensive management of sheep is directly linked to the environmental conditions (Mapiliyao, 2010). Variation in precipitation will cause fluctuations in forage quality and quantity, forage conservation utilisation, and consequently, changes in sheep condition indices and populations and this has got influence on flock dynamics (Angassa and Oba, 2007).

2.5 Age and sex as factors affecting wool quantity

There is increasing evidence that genetic parameters of lifetime wool production vary with age and sex (Hanford *et al*, 2003). Wool production is influenced by age and sex of animals, and by reproduction in the ewe. Less wool is grown by young animals per unit of feed intake, presumably due to competition for nutrients between follicles and other tissues. Maximum fleece weights in sheep have been observed as from three to five years of age, with variable rates of decline in wool production thereafter (Corbett, 2001). Nosratollah *et al*. (2012), reported that, in yearling sheep, the males were significantly heavier than females, but females had higher wool than males, and there was no significant effect of sex on wool characteristics. Age had a significant influence on body weight and greasy fleece weight, but males and females had similar output (Nosratollah *et al.,* 2012). The number of active follicles decrease with age, though there is no clear evidence that the synthetic ability of follicles also decreases. Reductions in wool growth with age could be related to changing patterns of feed intake and diet selection. Various quality characteristics tend to deteriorate with age, and crimp abnormalities may appear. This increasing fleece production is offset by a steadily increasing fibre diameter with age, which reduces the value of the fleece (Nosratollah *et al.,* 2012).

Rams tend to produce more wool than wethers and ewes, due mainly to their greater size and the better feeding given to rams. Differences between wethers and ewes, once the effects of reproduction in ewes are allowed for, are probably small (Corbett, 2001). There can be substantial reductions in wool growth rate during both the latter half of pregnancy and early lactation. Overall, reproduction usually reduces annual fleece growth of ewes by 10 to 14%; the greatest reduction being for ewes rearing twins (Corbett, 2001). Increased feed intake can compensate for the effects of pregnancy and lactation on wool growth in low-producing, but not in high-producing sheep (Oddy and Annison, 2000).

The change in wool production and quality traits with age will allow decisions on the optimal age structure of flocks to be determined (Clarke *et al.,* 1999). It is well known that wool production and wool quality characteristics can alter substantially with increasing age of sheep. Previous studies predominantly using medium to strong wool merino strains, identified a general trend of wool production increasing to 3 to 4 years of age and then declining (Clarke *et al.*, 1999). Although variable results have been observed with respect to wool quality traits to gradually deteriorate with age. Nutrition, physiological state, parasites and diseases are the factors that affect wool quantity. An increase in wool production achieved by improved nutrition is almost always allied with an increase in the mean thickness of the fibres (Khan *et al*., 2010).

2.5.1 Nutrition

Differences in the source of nutrients to the follicles can exert a considerable influence on the rate of fibre production and the physical characteristics of the fleece. (Khan *et al*., 2010). Most sheep are kept under free ranging conditions and the quantity and quality of feed available to them may vary considerably throughout the year. Therefore, the peak rate of wool growth is frequently two to three times the lowest rate for grazing sheep (Brown and Williams, 2000).

The wool growth of Merino sheep will respond to changes in nutrition throughout the year, but breeds with a large inherent rhythm in wool growth rate, such as the Scottish Blackface, show little or no response to changes in nutritive status during winter (Allden, 2001). There is no general agreement on the precise form of the relationship between wool growth and feed intake. Allden (2001) concluded available evidence points to a positive linear relationship between intake of digestible dry matter and wool growth, and states that there is no unequivocal evidence for a straight relationship although, this may occur at rates of wool growth approaching the genetic potential (Black and Reis, 2001). It has been suggested that wool growth rate is influenced by the extent and direction of body weight change. However, Allden (2001) has concluded that there is no convincing evidence that weight change has any effect on wool growth rate.

The relative importance of energy or protein supply for wool growth remained unresolved until the special features of ruminant digestion were taken into account. When ruminal degradation of protein is avoided, substantial increase in wool growth rate can be obtained with protein, and only small responses associated with energy (Allden, 2001). Reis (2000) showed that very high rates of wool growth could be obtained with moderate energy intakes when casein was given through the abomasum. As protein available for digestion and absorption in the small intestines is related to digestible energy intake, energy frequently appears to be the main dietary factor correlated with wool growth. Both length growth rate and diameter of fibres are increased (Black and Reis, 2001). These changes represent a three-fold increase in volume of fibre produced. In contrast to these effects, some protein or amino acid treatments, given post-ruminal, can adversely affect wool growth and may also produce differential effects on length growth rate and diameter of fibres (Reis and Panaretto, 2001). Whereas a balanced mixture of essential amino acids is required for high rates of wool growth, the supply of sulphur-amino acids plays a major role in regulating the growth and composition of wool.

The major constraint is cystine, but methionine, which can be readily converted to cystine, is equally effective for stimulating wool growth. But, excessive amounts of methionine are inhibitory. It has been suggested that some effects of amino acids on wool growth may be mediated through the endocrine system, but clear evidence is lacking (Khan et al, 2010). Manure ensiled wheat straws treated with 0.4% urea may contain maximum true protein nitrogen (Khan and Qadir, 2008). May be helpful to increase the wool and mohair production by sheep and goats because the composition of wool is markedly influenced by the nutrition of the sheep. An increase in the supply of cystine to the follicles increases the proportion of ultra- high-sulphur proteins and hence the sulphur content of wool. The proportions of high-tyrosine proteins in wool are also influenced by various nutritional treatments, but a control mechanism has not been identified (Khan et al, 2010).

Many of the effects of minerals appear to be due to changes in the supply of major nutrients brought about by changes in feed intake or in the balance of nutrients flowing from the rumen. Specific effects on fibre growth have only been demonstrated for zinc and copper, and even some of these may be related to changes in feed intake (Purser, 2000). Zinc deficiency in sheep causes brittle wool and loss of crimp; extreme deficiency causes cessation of fibre growth and fleece shedding. In goats of an undefined breed, zinc deficiency has been reported to cause reduced length growth of hairs (Khan *et al*, 2010).

There is no evidence that higher than adequate levels of zinc influence wool growth (Brown and Williams, 2000). Copper deficiency causes depigmentation of wool in black sheep and the steely wool syndrome. Wool growth rate is reduced by this deficiency but a reduction in feed intake may be involved. Copper supplementation may specifically stimulate wool growth but the evidence is meager (Purser, 2000). Various B vitamins may impair hair growth and are important for maintaining high rates of hair growth because of its role as a co-factor for enzymes involved in the metabolism of methionine and cystine. However, there is no experimental evidence for an effect of the supply of individual vitamins on wool growth. It has generally been assumed that the rumen micro-organisms synthesize sufficient B vitamins for the animal's needs, but proof is lacking for high rates of wool growth (Khan *et al*, 2010).

2.6 Factors affecting wool quality

The biology of skin and wool growth in sheep has been extensively studied since the 1950's and the developmental processes at the cellular level are reasonably well understood (Purvis and Franklin, 2004). The basic units used in the study of biology of wool growth are the wool follicle and the fibre growing from it (Purser, 2000). The genetic improvement of sheep bred primarily for wool production has been slow relative to other livestock species; this cannot be blamed on the tools available to the breeders and advisor geneticists. In most countries where wool sheep are grown, there is quite a sophisticated wool market and market intelligence, and the important price determinants are well quantized and communicated (Purvis and Franklin, 2004).

Wool quality can be affected by genetic and environmental influences. Genetic influences would be to select sheep with higher quality wool, while environmental influences might include nutrition, sheep management, and shearing management. Genetic selection should consider which traits are more heritable or more likely to pass to the lambs. Traits that are highly heritable include variation in fiber diameter, face covering, staple length, crimps and skin folds. Traits that are moderately heritable include fleece, clean wool yield, fiber diameter, and fiber density. Of those traits that are important in an economic sense, most are either moderately or highly heritable, and are easy and inexpensive to measure to a level of sufficiently precise for animal evaluation (Purser, 2000).

For the few traits where measurement is difficult or expensive, such as staple length, there are good indirect measures. For example, co-efficient of variation of fiber diameter has been shown to deliver significant gains when used as a selection criterion in breeding programs focused on apparel wool goals (Purvis and Franklin, 2004). Another factor that relates to wool production is body weight because large sheep have more surface area to produce wool. Thus large sheep produce more wool than small sheep. Williams (1991) states that factors determining the value of wool are fleece weight and yield, fibre diameter, staple length, vegetable matter, colour and style.

The environment can influence wool quality in a number of ways. First is the nutrition of the sheep. Ewes tend to be stressed during the last trimester of their pregnancy and while nursing lambs (Williams 1991). This has a direct effect on the fiber diameter that is being produced. If the nutritional level of the ewe meets her needs or is above what her needs are, the fiber diameter remains constant. The ewe becomes stressed in the latter stages of pregnancy and after lambing, that fiber diameter may decrease which creates weak quality. Staple length is also affected by nutrition. Sheep fed with high nutrition tend to have higher fleece weights than sheep fed on a low plane of nutrition and the increase in weight arises principally from an increase in the diameter of wool fibres and an increase in the length of fibres, rather than a change in the number of fibres growing (Teasdale, 1991).

Two ways to minimize a decrease in wool quality are to make sure ewes are feeding on ration that meet their needs and to shear ewes prior to lambing (Pattinson, 1981). If the fibres do have weak areas, the weakness is closer to an end of the fiber than if the ewes had long wool at lambing and ewes are not sheared until after lambing. It is also a good practice to have ewes in short wool at lambing time as lambs are less likely to suckle wool tags instead of the teat. As mentioned previously feeding management will affect the quality of wool if large amounts of feed contaminate the wool. Feeders should be low enough for sheep to eat without pulling hay down on top of their heads. Throwing hay over the backs of the sheep should be avoided (Pattinson, 1981).

A sheep graze they come in contact with bushes, weeds, trees and other forms of plant material. If the material is smooth it will generally fall out of the fleece but spiny or hairy, burrs and seeds usually become entangled in the wool. This material has to be removed from wool in the manufacturing process and different forms of plant material vary in the ease with which they can be removed (Pattinson, 1981).

Wool is contaminated by several factors and thus they reduce the value of domestic wool clip. There are three important categories of contamination while the wool is still on the sheep. The first factor is naturally occurring such dung, urine and yolk stains. The second factor is applied sources, which are generally manmade in origin and applied by man such as branding fluid, dewormer compounds and external sprays. Third factor are acquired contaminants, which can be animal, vegetable matter or mineral in the nature (Khan, *et al*., 2010).

Natural contaminants are produced by the sheep themselves. While one cannot prevent this from being produced there are management practices that can minimize their effect on wool quality such as follow: pigmented fibers; Cull individual sheep with dark pigmented skin; Careful selection of rams and replacement ewes; Urine; Dung; Crutch or shear prior to lambing or before placement on lush feed; Acclimate sheep to changes in feed; Maintain a sound and timely dewormer program; Yolk; Over feeding high energy feeds in periods of high temperatures and humidity; Cull sheep or breed types that have more than normal yellowing; Shed stain; Pen and remove feed and water for at least 4 hours before shearing (Williams 1991).

Vegetable matter: Seeds (grass and weed seeds); Burrs; Straw; Chaff. If it is impracticable to eradicate the contaminant plants from grazing area or rangelands, there are several replacements. Suggestions include: grazing areas before the problem seeds are produced or after they are removed; skirting the fleece to remove heavily contaminated wools; not bedding sheep on hay or straw before shearing; eradicating overhead hay feeders (Khan, *et al*., 2010).

Animal: Other livestock run in coincidence with sheep can reduce wool quality. This is not only from cross contamination with other animal fibers, but includes manure. External parasites also add to wool contamination from eggs, feces and the parasites themselves, all of which can stain the wool (Pattinson, 1981). Elude close proximity to livestock that are shedding such as in the same barn or pens; Cross contamination of colored wool fibers from different sheep breed types should be minimized; Companion animals (guard dogs, work dogs) will shed hair that can contaminate wool; Shearing shed and pens need to be thoroughly cleaned after shearing Angora goats; Housing moulting poultry near sheep can cause large amounts of feathers and manure to contaminate the wool; During shearing chickens have a tendency to lay eggs in open wool sacks and even sometimes have a fleece thrown on top of them to be shipped to the mill (Pattinson, 1981).

2.7 Current state of bush encroachment in communal rangeland

The communal grazing lands have been reported to have induced the invasion of bush encroachment to a level above 60%. This has resulted in the reduction of grass cover, poor rangeland conditions, and subsequently poor livestock productivity (Archer *et al*, 1995). Rangeland might be well-defined as the land on which native vegetation is mostly grass, grass-like plants, forbs, or shrubs that are grazed or have the possibility to be grazed. Rangeland is managed as a natural environment for grazing livestock and also as wildlife habitat (Allen *et al*, 2011). The productivity of rangeland is threatened by land degradation mostly characterized by soil erosion and bush encroachment. Bush encroachment is considered a threat to rangelands because of the suppression of productivity of herbaceous plant species (Ward, 2005). However, it is essential to understand their distinction so that the methods in addressing their different characteristics and impacts on rangelands are informed by clear understanding.

In South Africa, the worst affected areas by bush encroachment are in the Northern Cape, Eastern Cape and Limpopo Provinces (Allen *et al*, 2011). Ward (2005) reports that controlling bush encroachment is expensive and as a result the majority of farmers are not able to afford bush clearing. In addition, bush encroachment is observed as the most devastating threat to both sustainable livestock production and suitable standards of living in rural areas. In 1956 it was estimated that almost 13 million hectares in South Africa had been badly affected by bush encroachment (Archer *et al*, 1995).

One way of improving sheep production in communal areas is to improve grazing management. Feed resource availability is a major determinant of sheep productivity in communal rangelands (Angassa and Oba, 2007). Rangeland degradation has been observed on every continent where arid and semi-arid savannas occur (Archer *et al*, 1995). Because they are usually too dry to support most crops, rangelands are predominantly used for sheep grazing. Livestock grazing is the primary cause of desertification globally (Mabbutt, 1984).

It is one of the biggest environmental challenges. It has become a major concern to society because of its potentially adverse impacts worldwide. There are already increasing concerns globally regarding changes in climate that are threatening to transform the livelihoods of the vulnerable population segments. The earth's climate has warmed on average by about 0.7◦C over the past 100 years with decades of the 1990s and 2000s being the warmest in the instrumental record (Watson, 2010). In South Africa, studies have indicated that bush encroachment is already occurring (Madzwamuse, 2010). Examples of working groups on bush encroachment are the Environmental Monitoring Group (EMG) and the Indigo development and change (Indigo-dc) whose purpose is to help affected communities to improve the ability to respond effectively to bush encroachment.

The most important aspect is the awareness of the negative impacts bush encroachment might have on sheep production in the Eastern Cape Province and adaptation measures thereof. We can also expect that the sheep systems based on grazing and the mixed farming systems will be more affected by bush encroachment than an industrialized system. Thornton *et al*. (2009) cited by Notenbaert *et al*. (2011) observed climatic trends that included reduced productivity of animal feed, higher disease prevalence, and reduced fresh water availability. This was due to the negative effects of lower rainfall, more droughts on crops and on pasture growth, direct effects of high temperature and solar radiation on animals. According to FAO (2009), livelihood systems are vulnerable to bush encroachment.

Grazing sheep are expected to be negatively affected by climate change. According to Madzwamuse (2010), rainfall will be reduced and thereby reduce fodder production while increasing marginal costs of ranching. Most of South Africa, especially the drier parts, is used for grazing sheep. By 2050, South Africa is expected to face water scarcity because it is experiencing frequent droughts. Rainfall is highly variable in spatial distribution and is unpredictable (Madzwamuse, 2010).

South Africa's natural ecosystems such as rangelands are under threat posed by bush encroachment (Macdonald *et al*, 1986) and 10 million hectors in South Africa has been affected by bush encroachment (Le Maitre *et al*, 2000). There is some sort of diverse concern about the effects of bush encroachment on rangeland ecosystem productivity and sustainability. Consequently, human communities and natural ecosystems worldwide are under obstruction from a growing number of destructive invasive alien species (Richardson and Van Wilgen, 2004). These species grind down natural capital, compromise ecosystem stability, and threaten economic productivity of rangeland ecosystems. In addition, the effects of bush encroachment in agriculture, forestry, and human health are also widely recognised as the second-largest global threat to biodiversity (Richardson and Van Wilgen, 2004).

2.8 Common bush species in the communal areas

Rangelands are threatened by different bush species the most dominating are some *Acacia* species, viz. *A. mellifera, A. karroo, A. reficiens, A. tortilis* and *Dichrostachys cinerea*, which have thorns and secondary compounds (for instance phenolic) which discourage herbivores from navigating between trees (Salem *et al*., 2006). It is suggested that rainfall quantity and frequency might have an important role in the incidence of bush encroachment.

According to studies *Acacia karroo* is the dominant bush species in semi-arid savannas of South Africa and is an ecological threat of our modern era. *Acacia karroo* (Fabaceae = Leguminosae) trees are abundant and capable to grow in severe and waterless conditions ((Ehrenfeld, 2003). *Karroo* trees are the main bush trees in the Eastern Cape. The majority of bush encroaching species in rangelands is dominated by the genus Acacia, which is the second largest with over 900 species (Prins and Loth, 1988), and the Australian Acacias are important invaders of South African rangeland areas (Ehrenfeld, 2003).

Numerous estimations have been made of the spatial degree of alien plant invasions in South Africa (Richardson and Van Wilgen, 2004). About 10 million hectares of South Africa has been invaded by the approximately 180 species that were mapped (Le Maitre *et al*., 2000). However the principal invaders are trees and shrubs in the genera *Acacia*, *Hakea* and *Pinus*. Localization of invading species distribution is predisposed by the landscape formation gradient, thus, there are dense invasions in the mountains and lowlands and along the major river systems (Richardson *et al.*, 1997).

The susceptibility of rangelands to bush encroachment varies between the vegetation types. Thus, vegetation types such as grassland and savanna biomes are widely invaded mostly by species such as Australian wattles (*Acacia* species), other tree species, and a variety of woody scramblers (notably, triffid weed, *Chromolaena odorata*, and brambles, *Rubus* species). Invading trees such as jacaranda (*Jacaranda mimosifolia*) and syringa (*Melia azedarach*) have spread into semi-arid savanna by spreading along perennial rivers (Chamier *et al.*, 2012). In the Nama Karoo, woody invaders, notably mesquite (*Prosopis* species), have invaded large areas of alluvial plains, seasonal and ephemeral watercourses. Several cacti (*Opuntia* species) and saltbushes (*Atriplex* species) have invaded large areas of the Nama Karoo and Succulent Karoo and the thicket biome in the Eastern Cape (Chamier *et al.,* 2012).

2.9 Effect of bush encroachment on sheep production

Rangeland productivity is threatened by land degradation mostly characterized by soil erosion and bush encroached species. Bush encroachment is considered a threat to rangelands because of the suppression of productivity of herbaceous plant species (Ward, 2005). Bush encroachment has severe impact on biodiversity (Meik *et al.,* 2002). Bush encroachment decreases the diversity of habitats, and this in turn decreases biodiversity as a whole (Meik *et al.,* 2002). Bush encroachment results in habitat degradation (de Klerk, 2004) that has serious economic implications in the agricultural sector in South Africa. According to Richter and Meyer (2001) bush densities in excess of 2500 tree equivalent, depending on the species and the affected area, can destroy grass production by as much as 82% in years of average rainfall.

Bush species also results in lower productivity of individual animals (Kruger, 2002). Most encroaching bush species are less palatable to domestic livestock (Wiegand *et al.,* 2005). According to Els (1995) bush encroachment remains the single most important factor that limits red meat production and wool production in commercial farms in South Africa. Bush encroachment has adverse effects on livestock farming, it results in the decline of livestock production, due to the loss of grass on grazing lands (Woiters, 1994). Bush encroachment has also reduced the carrying capacity of South African rangelands. Bush encroachment continues to cause substantial losses in communal farms, resulting in lower food security and nutrition (Wigley *et al.*, 2010).

Further than the suppression of herbaceous vegetation by encroaching species, the higher bush density in rangelands reduces land accessibility by livestock, and that subsequently negatively affects the utilisation of rangelands. Moreover, due to competition for light, water, and nutrients between native and invading species, the grazing capacity of rangelands declines (Ward, 2005) and plant biodiversity becomes compromised (Wigley *et al.*, 2010). Therefore, bush encroachment is considered one of the largest threats to the ecosystems of the earth (Van Wilgen *et al*., 2004), and the services that they offer to humanity (Kaiser, 1999). Acacia species are characterized by quick spread and they displace native vegetation and disrupt important ecosystem processes, and that leads to serious environmental impacts (Bright, 1998). There are a number of sources for invading species, however, in natural ecosystems such as rangelands some alien tree species used in commercial forestry and agroforestry cause major problems as invaders (Moleele *et al.*, 2002).

Bush species can be found in different ecosystems, however, in South Africa, they are a significant environmental problem in terrestrial and freshwater ecosystems (Richardson *et al.*, 1997). Bush encroachment on rangelands, therefore, have negative effects on rangeland biological and economic value. Hence, bush encroachment results in rangeland degradation, which leads to decline of rangeland efficient capacity and subsequently on increased food insecurity and poverty. Hence, the introduction of bush plant cover in grasslands and their increase in savanna ecosystems is an indication of rangeland degradation (Oba *et al*., 2000). The foregoing statement is aligned with the definition of rangeland degradation, which states that reduction or loss of biological, and economic productivity ascends from inappropriate land use practices (Oba *et al*., 2000).

2.10 Summary

Persistent overgrazing as influenced by stocking rate, results in changes in the botanical composition of the veld (Tainton *et al.,* 1999). This change is often manifested as bush encroachment which tends to be common in the communal sheep farming areas. Bush encroachment is considered a threat to rangelands because of the suppression of productivity of herbaceous plant species (Ward, 2005). Communal farmers tend to favour the free-range system due to its being cheap. As a result by Salem et al. (2006), reported that there have induced the invasion of bush encroachment to a level above 60%. Rangelands are threatened by different bush species with the most dominating are *Acacia* species, viz. *A. mellifera, A. karroo, A. reficiens, A. tortilis* and *Dichrostachys cinerea*, which have thorns and secondary compounds which discourage herbivores from navigating between trees (Salem *et al*., 2006).

Wool production is affected by both genetic and environmental factors and also the incidence of diseases (Khan et *al*., 2010). Flock dynamics in communal areas are affected by several factors such as mortality, slaughtering, birth, etc. Flock composition is influenced by death rate and reproductive performance. Therefore, management practices are necessary in any sheep farming enterprise to prevent diseases and production losses (Mapiliyao, 2010). Management practices should strive to ensure that sheep have access to nutritious feed and good quality water throughout the growth stages. The control and/or prevention of diseases should also be considered with the framework of management practices. Sheep industry growth in countries is affected by diseases (Devendra *et al*., 2000). It is advisable that sheep should be dipped for lice 2–6 weeks after shearing to allow time for shearing cuts to heal. Sheep require shelter from the extremes of weather to reduce mortality. This may be as simple as a shelterbelt tree plantation, or a windbreak.

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Chapter 3

Sheep flock structure, sheep dynamics, and management practices under bush encroached and non- encroached areas of the Eastern Cape Province, South Africa

Abstract

A study was done in a bush encroached (Sheshegu) and a non-encroached (Mbewuleni) site in the Eastern Cape Province of South Africa with the aim of comparing sheep flock structure, sheep dynamics, and management practices. The study was conducted in two communal areas, namely Idutywa (Mbewuleni village), which represented an open grassland with no encroaching woody species, and Alice (Sheshegu village) which is a bush encroached site. Purposive sampling was used to select participating farmers. A total of 147 respondents were interviewed (73 in Mbewuleni and 74 in Sheshegu). A structured questionnaire was used to collect data on the aforementioned parameters from both villages. Analysis of the data was carried out using SPSS 2007 Version 16. The results indicated that the household head were predominantly married (80% Mbewuleni and 81% in Sheshegu, respectively), male (70 Mbewuleni and 82% in Sheshegu) farmers who were owning sheep. A greater percentage (66% in Mbewuleni and 53% Sheshegu attended secondary school, while 33% in Mbewuleni and 46% in Sheshegu attended primary) of these famers were also relatively uneducated and most were also unemployed with pension grants as the main source of income. Extensive farming is the livestock production system employed across the two villages with community grazing as their main source of feed. The sheep were allowed to graze separately from other livestock such as cattle during grazing period. The farmers do experience feed shortage, especially in the winter months (May to August) when dry conditions prevail. The farmers prioritized feed by feeding lambs and ewes but most of them do not supplement their flock. Shearing is done once a year in September or October. In both villages flock mating with no controlled breeding is practiced and the lambs usually come during the winter period. It was found that the non-encroached site (Idutywa) had a significantly ($P<0.05$) higher number of sheep with 14% of the households having numbers above 121 each, while in Sheshegu only 8% of household owned above 121 sheep. The non-encroached site had a significantly ($P<0.05$) higher number of ewes than the encroached site which correlates well with the observation that the village has more sheep. The incidences of lambing are high in the winter across the two villages. Mbewuleni showed the highest mortality rates in most of the months except for the three months of February, March and April. The study also revealed that incidences of sales and slaughter were high during March, November and December. It was concluded that location has impact on sheep flock structure, and dynamics. The study also reveals that the management practices employed in the two villages were basically the same. The conclusion from the study is that locality affects sheep flock structure and dynamics.

Key words: Bush encroachment, management practices, Sheep dynamics, Sheep flock structure, Open grassland.

3.1 Introduction

There has been concern that the state of communally grazed rangelands in South Africa and the other parts of the world that are dominated by bush encroached trees. Communal rangelands are commonly viewed as overstocked, overgrazed, degraded and unproductive (Ward, 2005) and this has resulted in interventions aimed at reducing numbers of sheep in an attempt to halt degradation. The best Management practices such as good health program, quality feeding, housing, production system, breeding and breeding methods played an important role to improve sheep productivity. Good knowledge of grazing, feeding and animal production is of cardinal importance (Stewart, 1995). South Africa has approximately 25 million sheep and about 25% of these are coming from communal farmers of Eastern Cape and Free State. Sheep play an important role in both commercial and subsistence farming systems and in the South African livestock industry as whole. In South Africa, sheep were widely distributed across the country where they contribute to the livelihoods of the rural population as a source of protein, wool, food security and poverty alleviation (Mapiliyao, 2010).

In accordance to United Nations Food and Agriculture Organisation (FAO, 2005) cited by Mapiliyao (2010), the world's largest sheep population was estimated at 1059.8 billion animals with South Africa contributing about 25.3 million. Besides contributing such significant important roles, sheep in the communal areas are not getting enough recognition. In the communal farming areas of South Africa, sheep graze in natural pastures or utilize crop residues (Mvinjelwa *et al*., 2014). Differences in agro-ecological zones exist and this has an effect on precipitation which has an effect on vegetation, with lowland rangeland having sweet veld grasses which are nutritious and palatable throughout the year. Highland rangeland have annual grasses which lose nutritive value and palatability during the dry season (Ellery *et al*., 1995). The impact of these differences in rangeland type on sheep in communal areas has an impact on sheep population dynamics (Mapiye *et al*., 2009).

The main economic sheep products are meat, milk, cash, leather, wool and other by-products such as dung for fuel or fertilizer. Sheep in communal area are a symbol of high status or an important symbol of wealth. The relative importance of each function varies with production system, rangeland type and farmers' socio-cultural factors as is the case with other animal species (Mapiliyao, 2010). Sheep have the ability to utilize rangelands that other domestic animals cannot, and have the ability to survive on limited amounts of coarse feed providing an opportunity for smallholder farmers to realise more income from raising sheep (Mapiliyao, 2010). Sheep are kept by communal farmers for special guests or for use at ceremonial gatherings such as weddings, funerals, chief installations, field days and circumcision ceremonies (Mapiye *et al*., 2009).

To produce a viable and sustainable developmental programme for the resource-limited farmers the challenges faced by communal farmers and their differences need to be understood. The information generated can act as a data base and can also assist policy makers to come up with sheep flock structure, dynamics, and management practices under bush encroached and non-encroached communal areas. The objective of this study is to determine **s**heep flock structure, sheep dynamics, and management practices under bush encroached and non-encroached areas of the Eastern Cape Province, South Africa. It is hypothesised that sheep flock structure, sheep dynamics and management practices are not affected by bush encroachment in the communal areas.

3.2 Materials and Methods

3.2.1 Description of the study area

The study was conducted in Dutywa and Alice which represent a non-encroached and an encroached site, respectively. The Mbewuleni village in Dutywa is about 25 km from Dutywa on the R61 road to Ngcobo. Dutywa is the seat of Mbhashe Municipality in the Amatole District. The region is classified as semi-arid and it normally receives 534 mm of rain per year, with most rainfall occurring during summer (December). It receives the lowest rainfall (7mm) in June and the highest (77 mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures range from 18.3 °C to 25 °C in February. The region is coldest during July when the mercury drops to 5.1 °C on average during the night. The village is an open grassland, and the vegetation is described as sweet veld. The dominating grass species are *Panicum maximum*, and *Cynodon dactylon* with scattered bush trees (*Acacia karroo*) along valleys.

Sheshegu is a communal area in Alice and is situated at 32° 46' 0" South, 26° 45' 0" East with an elevation of 563 m above sea level. According to the Fort Hare Research Farm (2001), Sheshegu receives an average rainfall of about 386 mm per year, with most rainfall occurring during summer. The average daily temperatures range from a minimum of 19 °C in June to maximum of 27.6 °C in February. The veld type is sweet veld and the grazing area contains grass and bush species. In the plains and valleys, grass species dominate and in valleys and mountainous areas, bush species dominate. According to (Mvinjelwa *et al*., 2014), the area is situated in a sweet veld type. In sweet veld, forage remains palatable and nutritious throughout the year (Ellery *et al*., 1995). The most dominating grass species include *Panicum maximum*, *Themeda triandra*, *Digitaria eriantha*, *Aristida congesta* and *Cynodon dactylon.* However, *Cynadon dactylon* dominates most near the homesteads where overgrazing almost always takes place. The area has a combination of plains, mountains and valleys. Bush species dominate more in valleys and in mountainous areas. The most dominating bush species include *Acacia karroo* species in the plains and valleys especially in areas that were previously used for crop cultivation. In the valleys, the main dominating bush species is the *Acacia karroo*, whilst the mountainous areas are dominated by *Olea africana* and *Ptaeroxylon oblique.*

3.2.2 Sampling procedure

Purposive sampling method described by Martin (2004) and Tracy (2007) were used to select the farmers who participated in the study. Only farmers involved in wool production were selected in the study. A structured questionnaire were used to collect data from the two villages. The questionnaire captured information such as sheep flock composition and dynamics and management practices under bush encroached area and open grassland. A total number of 147 respondents participated in the survey, 73 in Mbewuleni village in Dutywa and 74 respondents at Sheshegu village in Alice.

3.2.3 Data collection

3.2.3.1 Sheep flock structure

A questionnaires were used to collect information of the flock structure, it was focusing on different classes of animals such as numbers of rams, ewes, lambs, weaners, withers within a flock.

3.2.3.2 Sheep dynamics

About 30% of farmers which had large flocks (30 sheep and above) were selected purposively to participated for monthly sheep dynamics. A questionnaire was used to collect number of entries and exit within the flock. The reasons for entries were recorded and also reasons for exit were also recorded.

3.2.3.3 Management practices

The division of activities by different members of the family (men, women, boys, girls and workers) was recorded, which included the owner of flock, feeding of the flock, watering and health care of the flock. Feed resource were recoded such community grazing, road side grazing, and river side grazing, supplementation and crop residue. The ways of grazing were also recoded such that sheep were allowed to graze separately or were mixed with other livestock such as goat and cattle. The breeding system, type of breeding employed, lambing time, management of ewe during lambing, weaning method employed by communal farmers were recoded and mating time was also recorded. A selection criterion for rams and ewes was recoded. The selection criteria of rams normally used were as follows, breed character such as local pure breed, physical characteristics, and age. The sources of breeding stock were recorded such as purchase, community ram, or from the breeding flock. Selection criteria for ewes were colour, horn shape, tail length, performance history, and body conformation. The questionnaire gathered information such as mortality and their possible causes, and also the common diseases and occurrence of diseases, and veterinary drugs used to treat diseases and housing.

3.3 Data analysis

Analysis of the data was carried out using SPSS software (SPSS, 2007 Version 16). The analysis was essentially the determination of the frequency distribution of the parameters obtained through the questionnaire relevant to the objectives of the research. The frequency distribution informed one which parameter in the data was encountered most of the time. The distribution could thus be interpreted in terms of the objectives of the study.

The sheep dynamics data was subjected to analysis of variance (ANOVA) to compare the two villages using JMP 12 (SAS, 2015). The analysis was done in a way that compared the effect of the interaction between time of the year in months and locality. The results of the analysis are given in (table 3.7, 3.8 and 3.9) the results section using least square mean differences.

3.4 Results

3.4.1 Demographics

The demographics of the respondents from both study sites, Table 3.1, showed that males do practice farming as compared to females (Mbewuleni 70% vs 30%, Sheshegu was 82% vs 18%). The larger proportion (Mbewuleni was 80% to Sheshegu 81%) of males being married across the two villages. The ages showed that farming was predominantly practiced by senior citizens as almost half of the interviewed farmers (Mbewuleni was 47% and Sheshegu 34%) fell in the ages above 61 years old. Most of them were unemployed (Mbewuleni 72% to Sheshegu with 78%) and as such over half of them drew old age pension. Another observation was that most of the farmers were that most of the farmers did not attend tertiary education as only 1% in Mbewuleni village and 1% in Sheshegu village went to tertiary and above half (66% in Mbewuleni and 53% in Sheshegu villages attended secondary school) and 33% in Mbewuleni to 46% in Sheshegu attended primary school.

Table 3.1. Comparison of the demographic information of the respondents from the two study sites

Demography	Respondents	Mbewuleni	Sheshegu
Sex	1. Male	70%	82%
	2. Female	30%	18%
Age	1. <20	-	-
	2. 21-30	-	-
	3. 31-40	4%	16%
	4. 41-50	30%	32%
	5. 51-60	19%	18%
	6. >61	47%	34%
Marital status	1. Married	80%	81%
	2. Single	9%	10%
	3. Divorced	3%	4%
	4. Widowed	8%	5%
Level of education	1. Primary	33%	46%
	2. Secondary	66%	53%
	3. Tertiary	1%	1%
Employment status	1. Employed	23%	21%
	2. Unemployed	72%	78%
	3. Dependent	5%	1%
Source of income	1. Salary/wage	26%	19%
	2. Pension	61%	47%
	3. Other	14%	32%

3.4.2 Management practices

Extensive farming was the production system employed across the two villages with community grazing as their source of feed as shown in Table 3.2. The sheep were allowed to graze separately during grazing period. A large number of households from both villages experience feed shortages during the winter months; hence, they prioritized their feeding by feeding the lambs and ewes. However most of the farmers did not supplement (Mbewuleni 51% and 74% in Sheshegu) their flock. Shearing was done once a year in September in Sheshegu and October in Mbewuleni.

Table 3.2. Production system and animal feeding practices employed in each of the villages.

Production System and feeding	Parameter	Mbewuleni	Sheshegu
Production system	1. Extensive farming	100%	100%
Ways of grazing	1. Sheep graze separately	100%	100%
	2. Sheep mixed with other animals	-	-
Source of feed	1. Community grazing	97%	100%
	2. Road side grazing	3%	-
Source of water	1. Borehole	22%	14%
	2. Dam	8%	85%
	3. River	59%	19%
Flock supplementation	1. Yes	49%	26%
	2. No	51%	74%
Class of animal supplemented	1. Ewe	51%	74%
	2. Ram	19%	5%
	3. Wither	3%	4%
	4. Lambs	27%	17%
Type of supplement	1. Pellets	26%	11%
	2. Crip-feed	5%	14%
	3. Maize	51%	74%
	4. Lamb cubes	18%	1%

3.4.3 Breeding management practices employed in the two villages

Both villages practiced flock mating with no controlled breeding and the lambing incidences were observed during the winter period. Farmers in the two villages used rams from the breeding flock (Sheshegu 71% vs 37% Mbewuleni), community ram and purchased rams, shown in Table 3.2, respectively. The interviewed households used natural weaning to wean their lambs. Ram selection was done according to such characteristics as local pure breed, physical characteristics and age. Ewe selection was done according to color, history of performance, horn shape, body conformation and tail length. As shown in Table 3.3 most of the farmers across the two villages preferred to keep the indigenous breed. The farmer's reasons for preferring indigenous breed was because of their availability, quality of the meat, disease resistance, wool production, and the adaptability of the breed to local conditions.

Table 3.3 Breeding management practices employed in the two villages (percentage number of respondents)

Parameter	Level	Sheshegu	Mbewuleni
Breed preference	1. Indigenous breed	99%	100%
	2. Exotic breed	1%	0%
Type of mating	1. Natural mating	100%	100%
Lambing period	1. Winter	100%	100%
Management during lambing	1. Kept in the yard	69%	90%
	2. Allowed to go to grazing area with other sheep	31%	10%
Type of weaning	1. Natural weaning	100%	100%
Ram selection	1. Breed characteristics such as local pure breed/Physical characteristics/Age	100%	100%
Source of ram	1. Purchase	36	11%
	2. Community ram	27	18%
	3. Breeding flock	37	71%
Ewe selection	1. Color/History of performance/Horn shape/Body conformation/Tail length	100%	100%

3.4.4 Livestock housing in each of the two villages

As shown in Table 3.4 most of the farmers in the two villages used open kraals (Mbewuleni 81% vs Sheshegu 76%). In Sheshegu 73% vs 59% of household, separated lambs from mothers at night. About 16% of farmers in Mbewuleni village used rocks to build their kraals, 81% used poles to build their kraals, and about 3% of farmers used old materials. The majority of farmers in Sheshegu village used bushes to build their kraals 60% of them, while 40% of the farmers used old materials.

Table 3.4. Livestock housing in each of the two villages

Parameter	Level	Mbewuleni	Sheshegu
Type of kraal	1. Open kraal	81%	76%
	2. Shelter	19%	24%
Type of material used	1. Bushes	-	60%
	2. Rocks	16%	-
	3. Poles	81%	-
	4. Old material	3%	40%
Number of kraals	1. One	59%	73%
	2. Two	41%	27%

3.4.5 Sheep management practices employed in the two villages

Results for this are presented in table 3.5. It was found that famers from both villages kept sheep for similar reasons. The differences in mortality rates of the breeding flock were found to be insignificant with mortality cases resulting from such causes as cold weather, drought, predation and diseases (Table 3.5). There was no evidence to suggest that bush encroachment affected disease occurrence as both villages reported the same diseases. There were about 79% farmers from bush encroached site who reported that they dipped their sheep, while in non-encroached site there were about 82% practiced dipping. The dipping of sheep was done on a fortnightly basis. Most households across the two villages dosed their sheep, 85% from non-encroached site and 92% from bush encroached site. There was no ($P>0.05$) in deworming sheep between the villages.

Table 3.5. Sheep management practices employed in the two villages

Parameter	Level	Sheshegu	Mbewuleni
Reason for keeping sheep	1. Meat consumption/cultural activity/wool production	99%	89%
	2. Status	1%	21%
Source of sheep	1. Bought	48%	41%
	2. Exchanged	3%	5%
	3. Inherited	49%	54%
	4. Stud breeder	-	-
Mortality in breeding flock	1. Yes	67%	85%
	2. No	33%	15%
Causes of mortality	1. Disease	57%	11%
	2. Predator	10%	7%
	3. Cold weather/disease/predator	1%	68%
	4. Cold weather/disease/drought	32%	14%
Common disease	1. Anaplasmosis/Foot-rot/Sheep scab/ Heartwater	56%	55%
	2. Anaplasmosis/Foot-rot	26%	28%
	3. Anaplasmosis/Sheep scab	18%	17%
Dipping	1. Yes	79%	82%
	2. No	21%	18%
Dipping frequency	1. Fortnightly	79%	82%
Dosing	1. Yes	92%	85%
	2. No	8%	15%
Dosing frequency	1. Before raining period	51%	45%
	2. Beginning raining period	41%	35%
	3. Mid raining period	8%	20%

3.4.6 Percentage livestock numbers in the two villages

Table 3.6 shows the results of the sheep dynamics and livestock inventory data analysis. It was found that the non-encroached site (Idutywa) had a higher ($P<0.05$) number of sheep with 14% of the households having flock numbers above 121, whereas that number was 8 % in Sheshegu. No evidence was found to explain the differences in number of rams whereas it was found that Idutywa had a significantly higher ($P<0.05$) number of ewes, withers, and lambs that correlated well with the observation that the village had more sheep.

Table 3.6. Livestock owner in the two villages

Livestock	Range of animal numbers	Sheshegu	Mbewuleni
Sheep	1. 1-30	24%	0
	2. 31-60	38%	32%
	3. 61-90	16%	38%
	4. 91-120	14%	16%
	5. > 121	8%	14%
Goats	1. 1-30	38%	60%
	2. 31-60	19%	8%
	3. 61-90	18%	2%
	4. 91-120	16%	30%
	5. > 121	9%	-
Cattle	1. 1-30	71%	68%
	2. 31-60	29%	10%
	3. 61-90	-	7%
	4. 91-120	-	15%
	5. > 121	-	-
Rams	1. 1	32%	27%
	2. 2	29%	49%
	3. 3	11%	8%
	4. 4	2%	15%
	5. 5	26%	1%
Ewes	1. 1-20	26%	4%
	2. 21-40	34%	16%
	3. 41-60	38%	41%
	4. 61-80	2%	18%
	5. > 81	-	21%
Withers	1. 1-10	83%	25%
	2. 11-20	14%	45%
	3. 21-40	3%	22%
	4. 41-60	-	8%
Lambs	1. 1-20	50%	23%
	2. 21-40	30%	45%
	3. 41-60	15%	18%
	4. 61-80	5%	10%
	5. > 81	-	4%

3.4.7 Comparison of selected sheep dynamics parameters between the two villages

Table 3.7 shows the gains (births and purchases) and losses (sales, slaughter, mortality and predation) in the sheep dynamics of the two villages. Mbewuleni, which represents the non-encroached site, had more ($P<0.05$) lambs, mature castrates and births when compared to Sheshegu. The respondents from Sheshegu buy and sell are significantly different (0.49 and 0.33) than Mbewuleni (0.42 and 0.27).

Table: 3.7. Comparison of selected sheep dynamics parameters between the two villages

Village	Sheep dynamics parameters (least square means)							
	Lambs	Mature castrate	Births	Purchase	Sales	Slaughter	Mortality	Predated
Sheshegu	$24.08^{B} \pm 0.66$	$5.27^{B} \pm 0.24$	$2.42^{B} \pm 0.19$	$0.49^{A} \pm 0.09$	$0.33^{A} \pm 0.07$	$0.41^{A} \pm 0.10$	$0.34^{B} \pm 0.06$	$0.44^{A} \pm 0.06$
Mbewuleni	$42.11^{A} \pm 0.66$	$9.27^{A} \pm 0.24$	$4.39^{A} \pm 0.19$	$0.42^{A} \pm 0.09$	$0.27^{A} \pm 0.07$	$0.69^{A} \pm 0.10$	$0.77^{A} \pm 0.06$	$0.28^{A} \pm 0.06$

^{AB} Means not connected by the same superscript within columns are significantly different (P<0.05).

3.4.8 Monthly comparison of selected sheep dynamic parameters (gains) between the two villages

Table 3.8 shows the least square mean differences comparing the two villages. The two villages where shown to be have different numbers of lambs on every month with the only similarities being observed during the months of April and May as shown table 3.8. The incidence of lambing was more in the winter period across the two villages. The purchase outcomes across the two villages were more during the months of June, November, and December. The difference was statistical insignificant (P>0.05), though the average mean from Sheshegu was higher (1.27) compared to Mbewuleni (0.77) in the month of June. The average mean from Sheshegu was less compared to Mbewuleni in the month of November (1.41 in Sheshegu vs 1.68 in Mbewuleni), while in December Sheshegu was 2.36 to Mbewuleni 1.68.

Table 3. 8. Monthly comparison of selected sheep dynamic parameters (gains) between the two villages

Months	Lambs		Mature castrate		Births		Purchase	
	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni
April	$5.59^{A} \pm 2.28$	$0.86^{B} \pm 2.28$	$5.36^{A} \pm 0.57$	$9.00^{B} \pm 0.57$	$5.59^{A} \pm 0.45$	$0.86^{B} \pm 0.45$	$0.14^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
May	$15.68^{A} \pm 2.28$	$20.45^{B} \pm 2.28$	$4.52^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$10.24^{A} \pm 0.45$	$19.5^{B} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
June	$26.98^{A} \pm 2.28$	$46.82^{B} \pm 2.28$	$4.91^{A} \pm 0.57$	$7.86^{B} \pm 0.57$	$11.41^{A} \pm 0.45$	$26.91^{B} \pm 0.45$	$1.27^{A} \pm 0.21$	$0.77^{A} \pm 0.21$
July	$28.85^{A} \pm 2.28$	$51.14^{B} \pm 2.28$	$5.41^{A} \pm 0.57$	$9.45^{B} \pm 0.57$	$1.50^{A} \pm 0.45$	$4.18^{B} \pm 0.45$	$0.50^{A} \pm 0.21$	$0.59^{A} \pm 0.21$
August	$28.82^{A} \pm 2.28$	$51.77^{B} \pm 2.28$	$5.41^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$0.36^{A} \pm 0.45$	$0.91^{A} \pm 0.45$	$0.23^{A} \pm 0.21$	$0.36^{A} \pm 0.21$
September	$28.91^{A} \pm 2.28$	$51.55^{B} \pm 2.28$	$5.41^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$0.14^{A} \pm 0.45$	$0.27^{A} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
October	$28.09^{A} \pm 2.28$	$49.86^{B} \pm 2.28$	$5.41^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
November	$26.95^{A} \pm 2.28$	$49.14^{B} \pm 2.28$	$6.23^{A} \pm 0.57$	$10.05^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$1.4 1^{A} \pm 0.21$	$1.68^{A} \pm 0.21$
December	$25.45^{A} \pm 2.28$	$47.00^{B} \pm 2.28$	$6.72^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$2.36^{A} \pm 0.21$	$1.68^{A} \pm 0.21$
January	$24.82^{A} \pm 2.28$	$45.59^{B} \pm 2.28$	$4.14^{A} \pm 0.57$	$8.23^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
February	$24.72^{A} \pm 2.28$	$45.59^{B} \pm 2.28$	$5.36^{A} \pm 0.57$	$9.50^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$
March	$24.41^{A} \pm 2.28$	$45.59^{B} \pm 2.28$	$4.14^{A} \pm 0.57$	$8.68^{B} \pm 0.57$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.45$	$0.00^{A} \pm 0.21$	$0.00^{A} \pm 0.21$

^{AB}means not connected by the same superscript within row are significantly different ($P<0.05$).

3.4.9 Monthly comparison of selected sheep dynamic parameters (Losses) between the two villages

It is however interesting to note that Mbewuleni showed the highest ($P<0.05$) mortality rates in October, November, and January. The study also revealed that the incidences of sales were more during May (Sheshegu 1 vs 0 Mbewuleni), these are not statistically different for sales at all except for the month of May only. In both villages they slaughtered more ($P<0.05$) sheep in the month of April, June, December, January and March refer on table 3.9. The predation levels were higher ($P<0.05$) for Sheshegu village in the month of June only. There were no forms of gift out/in and entrusted out/in during the study period. Mbewuleni represents the non-encroached region and as such has the highest number of sheep in terms of mortality and slaughter rates.

Table 3. 9. Monthly comparison of selected sheep dynamic parameters (Losses) between the two villages

Months	Sales		Slaughter		Mortality		Predated	
	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni	Sheshegu	Mbewuleni
April	0.14 ^{A} ±0.16	0.14 ^{A} ±0.16	0.09 ^{A} ± 0.24	0.18 ^{A} ±0.24	0.00 ^{A} ±0.15	0.05 ^{A} ±0.15	0.27 ^{A} ±0.14	0.05 ^{A} ±0.15
May	1.00 ^{A} ±0.16	0.00 ^{B} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.00 ^{A} ±0.15	0.05 ^{A} ±0.15	0.19 ^{A} ±0.15	0.14 ^{A} ±0.15
June	1.32 ^{A} ±0.16	1.05 ^{A} ±0.16	1.18 ^{A} ±0.24	4.77 ^{B} ±0.24	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15	1.31 ^{A} ±0.15	0.14 ^{B} ±0.15
July	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.00 ^{A} ±0.15	0.23 ^{A} ±0.15	0.68 ^{A} ±0.15	1.09 ^{A} ±0.15
August	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.09 ^{A} ±0.15	0.23 ^{A} ±0.15	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15
September	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.00 ^{A} ±0.15	0.5 ^{A} ±0.15	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15
October	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.45 ^{A} ±0.15	2.05 ^{B} ±0.15	0.41 ^{A} ±0.15	0.14 ^{A} ±0.15
November	1.18 ^{A} ±0.16	1.41 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	1.64 ^{A} ±0.15	2.82 ^{B} ±0.15	0.55 ^{A} ±0.15	0.32 ^{A} ±0.15
December	0.36 ^{A} ±0.16	0.36 ^{A} ±0.16	1.05 ^{A} ±0.24	0.95 ^{A} ±0.24	0.95 ^{A} ±0.15	1.45 ^{A} ±0.15	0.55 ^{A} ±0.15	0.45 ^{A} ±0.15
January	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	1.59 ^{A} ±0.24	1.55 ^{A} ±0.24	0.95 ^{A} ±0.15	1.91 ^{B} ±0.15	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15
February	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	0.00 ^{A} ±0.24	0.00 ^{A} ±0.24	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15	0.82 ^{A} ±0.15	0.59 ^{A} ±0.15
March	0.00 ^{A} ±0.16	0.00 ^{A} ±0.16	1.00 ^{A} ±0.24	0.77 ^{A} ±0.24	0.00 ^{A} ±0.15	0.00 ^{A} ±0.15	0.45 ^{A} ±0.15	0.36 ^{A} ±0.15

^{AB} Means not connected by the same superscript within row are significantly different ($P<0.05$).

3.5 Discussion

3.5.1 Demographic information

The summary of variables presented in table 3.1 comprising of demography, In terms of the demographic characteristics of the samples, the summary statistics suggested that the majority of farmers were males (Mbewuleni 70% to 30% and Sheshegu 82% to 18%). This agreed with the findings reported by Kunene and Fossey (2006) in Northern Kwa-Zulu Natal where most of the households were headed by males and fewer households were headed by widows or wives of migrants. The outcomes for this study showed that farming was predominantly practiced by old people since almost half of the interviewed farmers (Mbewuleni was 47% and in Sheshegu 34%) fell in the ages above 61 years old. It had been reported that the number of households practicing farming in Kwa-Zulu Natal were old age people (Statistics South Africa, 2011). The age group of farmers practicing farming in Kwa-Zulu Natal were individuals between 45 and above 65 years (Statistics South Africa, 2012).

The results showed unemployment rate being (Mbewuleni 72% and Sheshegu 78%) high across the villages and as such over half of them draw old age pension. Another observation was that most of the farmers were relatively uneducated since only 1% in Mbewuleni village and Sheshegu villages of them went to tertiary and above half (66% in Mbewuleni and 53% in Sheshegu village) obtained secondary education while 33% in Mbewuleni to 46% and Sheshegu attended primary school. These finding agreed with results reported by Mahlobo (2016) that approximately 31% had lower education at school, 35% had primary education, 29% secondary education, and only 5% had tertiary qualification. These findings confirm statements of that most communal livestock's owners were unemployed, with low levels of education. The implication of education is lack access to information about the market structure and opportunities, consumer demand and preferences. Lack of access to product price and/ or market structure compromised farm productivity and profitability.

3.5.2 Management practices

Extensive farming is a production system employed by most farmers in the communal areas of the Eastern Cape Province. This could be caused by small land available for communal farmers to create camps to practice rotational grazing and lack of fencing and there is no communal farmer owning a grazing land could be another cause. In accordance with the study reported by Mvinjelwa *et al*. (2014), extensive farming is whereby sheep are allowed to graze in the community grazing area and natural flock mating is the breeding system employed. This agrees with the findings of this study, extensive farming is the production system employed across the two villages with community grazing as their source of feed. Shearing time is done once a year during the months of September and October. The study also agrees with findings of Hailemariam, *et al*. (2013), in a study done in Ethiopia, the production system employed by farmers was communal grazing and private pasture grazing as the main feed resources. Ajala *et al*. (2003) also reported that sheep were found in the semi-arid zones of Nigeria and allowed to utilize extensive management systems, community grazing as the source of feed throughout the year.

The farmers across the two villages did experience challenges of feed shortage caused by drought affected the study site during study period. About 81% of farmers in Mbewuleni and 97% in Sheshegu reported that they experienced feed shortage especially in the winter months when there was less vegetation in most areas during that period. They prioritized their feeding by feeding their lambs and ewes and most of them did not supplement (Mbewuleni 51% and 74% in Sheshegu) their flocks. This agreed with the findings reported by Makapela (2008). In this study, most of the farmers did not supplement their animals during a normal season or a dry season. During the lactating phase, 73% of farmers did supplement the lactating ewes using planted pastures. Other farmers (19.27%) used rested veldt as a form of supplementary feeding for the lactating ewes.

3.5.3 Livestock inventory and sheep dynamics.

It was found that the non-encroached site (Idutywa) had a higher ($P<0.05$) number of sheep with 62.5% of the households having numbers above 121 each coming from there, while in Sheshegu they were about 32% of household owning above 121. This could be caused by differences in vegetation and the fact that Sheshegu village was dominated by with bush trees. Ward, (2005), reported that bush encroachment had negative impact on grass production, as it suppressed the growth of palatable grass species loading to a negative effect on livestock productivity. Mapiliyao *et al*. (2012) stated that a rapid increase in woody population and degradation of grazing resources badly affected livestock production. The farmers across the two villages observed sheep mortality. The most affected class of animals were the lambs in both villages and this could be caused by the fact that their lambing time was in winter when there was less vegetation for grazing. The study areas were affected by drought during the study period, and also famers cited cold weather, drought, predation and diseases as the causative factors. Hailemariam, *et al*. (2013), corroborates this finding in their study reporting that most important causes of sheep mortality were diseases and parasites, feed shortage, lack of veterinary service and animal health professionals.

The mortality rates in small stock in communal systems were extremely high compared to systems with better management. The mortality rates resulted from theft, poor hygiene and predation (Webb and Mamaholo, 2004). The farmers across the two villages dipped their sheep on monthly basis, though in findings reported by Makapela (2008), in the Hewu communal area, all the sheep were dipped four times a year. All the farmers in the Hewu area dosed their animals twice per year. Once during the summer months and once during the early winter, while in this study farmers dosed their sheep four times and most preferably before rain period, followed by beginning of rainy period, mid rainy period and post rainy period.

3.5.4 Sheep dynamics parameters.

The incidence of lambing was more in the winter period across the two villages; this could be caused by continuous breeding employed across the two villages. The purchase, sales, slaughtering outcomes were more in June and November months across the two villages. This could be caused by the fact that traditional ceremonies were done during March, June, December holidays in most communal areas of the Eastern Cape. This agrees with the of Mapiliayo (2010), peak sales for Sompondo and Gaga took place in April, during the time of Easter celebrations, followed by June the period of food shortage and initiation of the boys. Slaughtering was at the peak in the hot-wet season (December) during the festive season, for sheep sold and consumed. This finding concurs very well with Coetzee *et al*. (2005), and Montshwe (2005) who reported a similar trend on cattle. Though, farmers got low prices for their sheep during the cool-dry season due to poor body condition, supplementary feeding could be an essential strategy to increase sheep off take in the two communal areas. On the other hand, farmers concentrate on selling their sheep at the end of the post-rainy season when they are still in good condition (Mapiliayo, 2010). There were no forms of gift out/in and entrusted out/in during the study period.

3.6. Conclusion and recommendations

The study revealed what had been observed in other previous studies. Communal farming is a practice that is undertaken by senior citizens who are predominantly married males. Consequently, most of the farmers are considerably uneducated with more than half only going as far as primary school. When it comes to management practices the system that is employed in both villages is extensive farming. The system is characterized by communal grazing with very few farmers supplementing. During the dry winter season when feed is short priority is given to lambs and ewes. Another characteristic of the farming system is that of flock mating where rams are selected based on local pure breed, physique and age. Ewe selection on the other hand is based on colour, performance history, horn length and body confirmation.

The sheep dynamics show that high levels of production are obtained in Mbewuleni (open grassland) relative to the encroached Sheshegu village. However, the mortality rate was also higher in the Mbewuleni. The effects of using the same system are visible when you observe that production levels are similar during the winter period when there are such factors as cold and shortage of feed. It was concluded that location has impact on sheep flock structure, and dynamics as from the result Mbewuleni represents the non-encroached region and as such has the highest number of sheep in almost all the categories with only the rams not showing any significant difference between the two villages. The study also reveals that, the management practices were employed across the two villages was common.

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Chapter 4

Wool production from sheep under bush encroached and non-encroached areas of the Eastern Cape Province, South Africa

Abstract

The study was carried out using 110 non-descript sheep breed in two communal areas in the Eastern Cape Province of South Africa. Ten sheep of each sex were taken from each village according to the three age groups except for the four teeth olds in Sheshegu. This gave a total sample size of 110 sheep. The data was collected based on animal related factors such as body condition score, age, sex, and weight. The selected sheep fleeces were sampled in October. Fleece samples (from the shoulder region) were taken after shearing. The sheep were measured for live weight after shearing, body condition score, and greasy fleece weight. Fleece weight was recorded immediately after shearing using Libra measuring instrument scale (1-5), and also body condition score was recorded using the 1 to 5 scale. The quantity and quality were determined based on wool weight, fibre diameter, color, staple length, and clean wool. The analysis of the data for wool quantity was carried out using SPSS 2007 Version 16. The data for wool quality was analyzed using the analysis of variance (ANOVA) to determine effect of system and animal related factors on wool production. The results revealed that there is no significant ($P>0.05$) while we comparing the average wool across the two villages and the sex. This implies that the sex of the sheep does not affect the quantity of wool produced. However, the quantity of wool produced by 6 tooth sheep is higher ($P< 0.05$) as compared to that produced by 4 tooth and 2 tooth sheep, respectively as evidenced by the higher mean difference of the 6 tooth old sheep (2.62 compared to 2.19 and 2.14, respectively). The location had a significant effect ($P<0.05$) on all parameters (mean fibre diameter, clean yield, crimp, crimp length, and diameter) except for the comfort factor. The effects were observed to be particularly more significant when it came to the clean yield with

Sheshegu sheep producing more (P< 0.05) clean yield than their Mbewuleni counterparts. The yield was shown not to be affected by both the age and sex of the sheep. The interaction of village and sex resulted in (P< 0.05) differences (P<0.05) in the crimp length (males had higher values) whereas that of village and age did not affect the yield and crimp length. It was concluded from this study that age, sex and weight are the factors that affect wool production (quantity and quality), though the difference for average wool weight for sex was not significant while wool production was different from the encroached and the non-encroached sites.

Key words: Bush encroachment, Wool production (quantity and quality), Open grassland, Animal related factors

4.1 Introduction

Sheep farming is wide spread in the communal areas of the former Transkei in the Eastern Cape Province of South Africa (Mvinjelwa *et al.*, 2014). The communal farmers kept sheep for different reasons, primarily for meat consumption and investment. Selling of wool was traditionally considered to be extra cash income. The wool was usually of poor quality and was sold to local traders at very low prices (Makapela, 2008). But wool production had potential as a source of cash income that could substantially contribute to household income, if the quantity and quality of wool is improved. In so far as it could lead to extra income, it had the potential to alleviate rural poverty and stimulate rural economic growth (Mapiliyao, 2010).

A recent joint initiative between National Wool Growers Association (NWGA), the government and the Agricultural Research Council (ARC) had an objective to improve the situation of the rural households by intensifying agriculture and in particular by the development of the small scale wool production. Small-scale wool production was stimulated by investment in shearing sheds and training in wool sorting, shearing and other practices (NWGA, 2011).

The first sheep that were kept at the South point of Africa were "vetstertskape" (Afrikaners) and were kept mainly for meat production. The first merino farming venture dates back to 1800 and started in the area of Darling in the Western Cape (NWGA, 2011). On the farm Grootpost, in Darling, the Cape Government bred pure merino rams to distribute amongst farmers. The upgrade from "inheemse" sheep to wool sheep, also pure merino sheep, started spreading quickly from 1850 (Brand, 1998) cited by (Makapela, 2008). The composition of wool sheep in South Africa is mainly Merino and Karakul. Around 74% of the total wool sheep is Merino sheep.

Woolled sheep breeders in South Africa are well organized in official breed societies. These are well aware of the dangers of black fibre and kemp contamination, breed standards require the absence of black and coloured fibres, and kemp before animals are allowed on the registers of these societies. More than 50% of the clip is produced in two provinces, namely the Eastern Cape and the Free State (Mvinjelwa *et al*., 2014). Historically, wool produced in the neighbouring states of Namibia and Lesotho has always been considered part of the South African production and has always been sold in South Africa (Makapela, 2008).

The sheep and wool industry is one of the oldest agricultural industries in South Africa and it plays an important economic role as an earner of foreign exchange for the country. As an export product, more than 90% of the total production is exported either as greasy wool or in semi-processed form as scoured and wool top (Mvinjelwa *et al*., 2014). The largest part of the South African wool clip is marketed overseas through members of the South African Wool and Mohair Buyers Association (SAWAMBA). Only registered members of SAWAMBA are allowed to bid at auctions held under the auspices of the South African Wool Exchange. Approximately 60-70% of South Africa's annual wool production is semi-processed in SA before exportation, while the balance is exported as greasy wool (NWGA, 2011).

In Eastern Cape Province during the 1997/98 season, about 222 610 kg of wool was sold through formal channels with a total value of R 1.5 million. This figure increased to 2 345 991 kg with a value of R 30 791 496 during the 2006/2007 season. The latter represents approximately 51.2% of the total clip of the Eastern Cape (NWGA, 2006/2007) cited by Makapela (2008). According to (NWGA, 2011) the export value of wool (not carded or combed) by the Eastern Cape Province to the world between 2001 and 2010 period increasing, whereas Cacadu, Amathole and Chris Hani Districts experienced low export values of wool during the period. The exports of wool from Nelson Mandela Metro started to increase in 2002, and then a decline occurred between 2003 to 2005 years. From 2006 to

2008 year, there was a consistent increase in exports of wool from the Nelson Mandela Metro to the world, until a peak was attained in 2008 at approximately R2.5 billion. Nelson Mandela Metro is a major exporter and nearest exit point of wool from South Africa to the world (Makapela, 2008). The objective of the study was to determine the effect of animal factors on quantity and quality of wool from sheep under bush encroached and non-encroached areas. It was hypothesised that null hypothesis was wool production (quantity and quality) was not affected by animal related factors (weight, sex, age and body condition score).

4.2 Materials and methods.

4.2.1 Study site

The study was conducted in Mbewuleni village in Dutywa region and Sheshegu village in the Alice region, as described in Chapter 3.

4.2.2 Sample selection

A sample of 110 non-descript sheep breeds were randomly selected from the two villages. The selected animals were 10 males and 10 females within each age group from each village with exception of the 4 teeth old males in Sheshegu. There were no males with 4 teeth in Sheshegu village. The data was collected based on animal related factors such as body condition score, age, sex, and body weight. The selected sheep fleeces were sampled in animal sheds in October.

4.2.3 Wool production measurement

Fleece samples were collected from the shoulder region. The sheep were measured for live weight after shearing, body condition scores, and greasy fleece weight during shearing time in October in the two villages. Fleece weight was recorded immediately after shearing using Libra measuring scale, and also body condition score was recorded by using 1 to 5 scale (Mvinjelwa *et al*., 2014).The quantity and quality was determine based on wool weight, fibre diameter, color, staple length, and clean wool. Williams (1991) said that factors determining the value of wool were fleece weight and yield, fibre diameter, staple strength, staple length, vegetable matter, colour and style.

4.3 Data analysis

The analysis of the data for wool quantity was carried out using SPSS 2007 Version 16. The analysis was essentially the determination of the effect of system and animal related factors on wool production (quantity). The PROC GLM (general linear model) of SPSS (2007) was used to analyse the effect of system, and animal related factors and their interactions on wool production (quantity). Tukey test was performed for separation of means.

The data for wool quality was analyzed using the analysis of variance (ANOVA) to determine effect of system and animal related factor on wool production (quality). The PROC GLM (general linear model) of SAS (2010) was used to analyse the effect of system, and animal related factors and their interactions on wool production (quantity and quality). Tukey test was performed for separation of means. The following statistical model used was:

$$Y_{ijklm} = \mu + \alpha_i + \beta_j + \delta_k + (\alpha\beta)_{ij} + (\beta\delta)_{jk} + (\alpha\beta\delta)_{ijk} + \varepsilon_{ijklm}$$

Y_{ijklm} = wool production; **μ** = overall mean; **α_i** = body condition score; **β_j** = age; **δ_k** = sex; **$(\alpha\beta)_{ij}$** = interaction of body condition score and age; **$(\beta\delta)_{jk}$** = interaction between of age and sex **$(\alpha\beta\delta)_{ijk}$** = interaction of BCS, Age and Sex, **ε_{ijklm}** = error

4 Results

4.4.1 Wool Production.

Table 4. 1: Effect of locality, sex, age and body condition score on sheep and wool weight (kg).

Parameter	**Village**		**Sex**		**Age**			**Body condition score**			
	Sheshegu	Mbewuleni	Male	Female	2teeth	4teeth	6teeth	Slightly thin	Thin	Fat	Obese
Sheep weight	$39.34^{A} \pm 0.66$	$34.34^{B} \pm 1.02$	$38.20^{A} \pm 0.78$	$35.48^{B} \pm 0.69$	$33.61^{A} \pm 0.91$	$37.9^{B} \pm 0.92$	$38.99^{B} \pm 0.76$	$29.55^{A} \pm 0.99$	$33.98^{B} \pm 0.59$	$37.87^{C} \pm 0.87$	$45.96^{D} \pm 2.03$
Weight of wool	$2.76^{A} \pm 0.11$	$1.88^{B} \pm 0.17$	$2.38^{A} \pm 0.13$	$2.25^{A} \pm 0.12$	$2.14^{A} \pm 0.15$	$2.19^{A} \pm 0.15$	$2.62^{B} \pm 0.13$	$1.80^{A} \pm 0.16$	$2.27^{B} \pm 0.10$	$2.21^{AB} \pm 0.14$	$2.99^{C} \pm 0.34$

^{AB}Means not connected by the same superscript within a parameter are significantly different ($P < 0.05$).

Table 4.1above shows that the village of Sheshegu had heavier sheep as evidenced by the significantly (P<0.05) higher value of 39.34 kg as compared to that of Mbewuleni which stood at 34.34 kg. This difference in live weight of sheep between the two villages also translated to a difference in wool weight that each village produced with Sheshegu once again having the higher value. The effect of sex resulted in a significant difference (P<0.05) when it came to sheep weight with no significant effect (P>0.05) observed for wool weight. On the other hand, the age of the sheep was shown to be a factor with wool produced by 6 teeth sheep being significantly (P<0.05) higher than that produced by 4 teeth and 2 teeth sheep, respectively. The body condition score of the sheep also affected the quantity of wool with significant differences (P<0.05) between wool of heavier sheep relative to that of smaller sheep

Table 4.2: Comparison of the effect of sex, age and body condition score on the wool weight (kg) between the two villages

Parameter	Level	Village	Least square mean of wool weight
Sex	Male	Sheshegu	$2.78^{A} \pm 0.19$
		Mbewuleni	$1.98^{B} \pm 0.18$
	Female	Sheshegu	$2.72^{A} \pm 0.12$
		Mbewuleni	$1.78^{B} \pm 0.20$
Age (number of teeth)	Two	Sheshegu	$2.43^{BC} \pm 0.19$
		Mbewuleni	$1.85^{CD} \pm 0.23$
	Four	Sheshegu	$2.65^{B} \pm 0.22$
		Mbewuleni	$1.74^{D} \pm 0.21$
	Six	Sheshegu	$3.19^{A} \pm 0.15$
		Mbewuleni	$2.05^{CD} \pm 0.20$
Body condition score	Slightly Thin	Sheshegu	$2.24^{BC} \pm 0.26$
		Mbewuleni	$1.36^{D} \pm 0.21$
	Thin	Sheshegu	$2.71^{B} \pm 0.15$
		Mbewuleni	$1.82^{C} \pm 0.12$
	Fat	Sheshegu	$2.71^{B} \pm 0.24$
		Mbewuleni	$1.70^{CD} \pm 0.16$
	Obese	Sheshegu	$3.36^{A} \pm 0.21$
		Mbewuleni	$2.63^{ABCD} \pm 0.64$

^{ABCD}Means not connected by the same superscript within a parameter are significantly different ($P<0.05$).

When comparing the two villages with respect to the effects of sex, age and body condition score (Table 4.2 above) Sheshegu maintains its superiority across all levels of each parameter with the exception of body condition score where obese sheep showed no differences. The male sheep weight from Sheshegu was more than those from Mbewuleni at 2.78kg to 1.98kg. The results also showed that the age of the sheep affected its weight with the weights of the sheep from each village increasing with age with the exception of Mbewuleni where the four tooth old sheep weighed less that the two tooth sheep.

4.4.2. Wool quality

The outcome shows that there was a significant difference on the wool quality parameters across the two villages refer on table below. The results shows that sex has effect on wool quality, as the female sheep has significantly difference in all the wool quality parameters, refer to table 4.3 below. Table 4.3 below shows that the interaction between locality and sex has significant difference ($P<0.05$), on all the quality parameters with the exception of clean yield. The study shows that age has significant influence in all the wool quality parameters with the exception of clean yield. The difference was observed between two teeth sheep and 6 teeth sheep. When looking at the interaction between locality and age it was observed that the influence on mean fibre diameter, clean yield and diameter is significant ($P<0.05$), while the influence on the crimp length was insignificant.

Table 4. 3: Effect of village, sex and age on selected wool quality parameters

Factor		Mean Fiber Diameter (µm)	Comfort Factor (%)	Yield (%)	Crimp	Crimp Length(mm)	Diameter (µm)
Village							
Mbewuleni		21.2^{B} ±0.27	91.99^{A}±0.80	59.92^{B} ±1.15	10.64^{A} ±0.25	62.82^{B}±2.04	21.28^{B} ±0.27
Sheshegu		22.18^{A} ±0.33	91.40^{A} ±0.97	72.75^{A}±1.41	9.60^{B} ±0.31	70.55^{A} ±2.50	22.17^{A} ±0.33
Sex							
Male		21.03^{A} ±0.27	93.63^{A} ±0.80	65.00^{A} ±1.15	10.68^{A} ±0.25	73.78^{A} ±2.50	21.09^{A} ±0.33
Female		22.35^{B} ±0.33	89.77^{B} ±0.97	67.67^{A} ±1.41	9.56^{B} ±0.31	59.58^{B} ±2.04	22.36^{B} ±0.27
Age							
2 Teeth		20.71^{A} ±0.33	93.86^{A} ±0.99	64.63^{A} ±1.43	9.66^{B} ±0.31	70.90^{A} ±2.53	20.72^{A} ±0.33
4 Teeth		22.24^{B} ±0.43	90.02^{B} ±1.28	67.46^{A}±1.86	9.62^{B} ±0.40	62.05^{B} ±3.28	22.25^{B}±0.43
6 Teeth		22.13^{B} ±0.33	91.22^{AB} ±0.97	66.91^{A} ±1.41	11.08^{A} ±0.31	67.10^{AB} ±2.50	22.20^{B} ±0.33
Village*Sex							
Mbewuleni	**Male**	20.87^{B} ±0.38	93.44^{A} ±1.13	60.29^{C} ±1.63	10.87^{A} ±0.35	63.77^{B} ±2.88	20.99^{B} ±0.38
	Female	21.54^{B}± 0.38	90.54^{AB} ±1.13	59.55^{C} ±1.63	10.41^{A} ±0.36	61.87^{B} ±2.89	21.57^{B} ±0.38
Sheshegu	**Male**	21.20^{B} ±0.54	93.82^{A} ±1.59	69.70^{B} ±2.31	10.50^{A}±0.50	83.80^{A} ±2.88	21.18^{B} ±0.54
	Female	23.16^{A} ±0.38	88.99^{B} ±1.13	75.79^{A} ±1.63	8.70^{B} ±0.35	57.50^{B} ±4.08	23.15^{A} ±0.38
Village*Age							

Mbewuleni	**2 Teeth**	21.30^{CD} ±0.48	91.30^{BC} ±1.41	57.89^{B} ±2.05	10.67^{A} ±0.45	67.84^{AB} ±3.63	21.35^{CD} ±0.48
	4 Teeth	20.70^{CD} ±0.46	92.79^{AB} ±1.35	59.41^{B} ±1.95	10.34^{AB}±0.42	59.85^{B} ±3.45	20.74^{CD} ±0.46
x	**6 Teeth**	21.61^{BC}±0.47	91.87^{BC} ±1.38	62.47^{B}±1.10	10.90^{A} ±0.43	60.75^{B} ±3.53	21.75^{BC} ±0.47
Sheshegu	**2 Teeth**	20.12^{D} ±0.47	96.41^{A} ±1.38	71.37^{A}±1.10	8.65^{C} ±0.43	73.95^{A} ±3.53	20.10^{D} ±0.47
	4 Teeth	23.77^{A} ±0.74	87.25^{C} ±2.18	75.52^{A} ±3.16	8.90^{BC}±0.69	64.25^{AB}±5.59	23.75^{A} ±0.74
	6 Teeth	22.65^{AB} ±0.47	90.57^{BC} ±1.38	71.36^{A} ±1.10	11.5^{A} ±0.43	73.45^{A} ±3.53	22.64^{AB} ±0.47

^{ABCD}Means not connected by the same superscript within a column are significantly different ($P<0.05$).

4.5 Discussion

4.5.1 Effect of village and animal sex on wool quantity (kg)

The study revealed that the average weight of wool from the encroached (2.76 kg) site is significantly greater ($P<0.05$), than that from the non-encroached site (1.88 kg). This could be caused by the fact that sheep from encroached site were on average heavier compared to those from non-encroached site. This also could be caused by the difference in vegetation types as the study areas had sour veld and sweet veld which are characterized by different grazing and nutritional qualities. The sweet veld with higher quality grazing could explain the better wool production observed in the study. In accordance with the findings of Mvinjelwa *et al*. (2014), the wool produced by the communal farmers in Eastern Cape ranges from 2–3 kg compared to the range of 3–5 kg per sheep in the commercial production. The lower quantity of wool produced per sheep in communal areas compared to the commercial sector may be caused by difference in management practices employed.

The was no difference was observed from average amount of wool obtained from males (2.38 kg) and the one from females (2.25 kg) across the two villages. This implies that the sex of the sheep does not affect the quantity of wool produced. In Arabi breed generally the males are heavier than females and produce higher greasy wool than females (Taherpour *et al*., 2003). The effects of sex and age on fleece weight in this study were not in agreement with previous findings (Nosratollah *et al*., 2012). They reported that, in yearling Romney sheep as well as Awassi sheep, the males were significantly heavier than females, but females had higher wool yield than males.

4.5.2 Effect of age, and weight on wool quantity (kg)

The age of the sheep has been shown to be a factor in that the quantity of wool produced by 6 teeth sheep was significantly higher compared to that produced by 4 teeth and 2 teeth sheep.

Harizi *et al*. (2015) found increased greasy fleece weights with age. In contrast, Khan *et al*. (2010) reported that fleece weight decreased with age. The weight of the sheep had also been observed to affect the quantity of wool with significant differences between wool of bigger sheep (bigger body condition score) relative to that of smaller sheep (smaller body condition score), more fleece had been observed. Mature ewes had on average a higher live weight and body condition scores than younger ewes. The higher the live weight and condition scores, the higher the fleece produced (Mvinjelwa *et al*., 2014). Age had a significant influence on body weight and greasy fleece weight, but males and females had similar output (Nosratollah *et al*., 2012). The two villages were also shown to have significantly different figures of wool weight for different levels of sex, age and body condition score (Table 4.2).

4.5.3 Effect of selected factors of wool quality parameters

Table 4.3 above shows the P-values obtained when testing the effects of the factors on the quality parameters of the wool from both villages. It was evident from the table that locality (village) had an effect on all parameters except for comfort factor. For Mbewuleni village, results were as follows: 21.2 (μm), 91.99 %, 59.92%, 10.64, 62.82mm, and 21.28(μm), while Sheshegu are: 22.18(μm), 91.40(%), 72.75(%), 9.60, 70.55(%), and 22.17(μm)) for the comfort factor. Abegaz *et al*. (2005) reported that average wool quality parameters were as follows: Clean yield (%) 71.8, staple length (mm) 89.7, fibre diameter (μm) 19.9. while findings reported by Olivier *et al*. (2000) were mean fibre diameter (μm), 19.26, staple length (mm), 102.72, clean yield (%), 67.78, number of crimps, 14.20 and comfort factor (%), 99.39.

The effects were observed to be particularly more significant when it came to the clean yield with Sheshegu sheep producing cleaner yield than their Mbewuleni counterparts. This could be caused by various factors leading to differences in quality. The most important being genetics, nutritional and environmental factors. This agreed with the findings reported by Khan *et al*. (2012) indicating genetic influence, nutrition, physiological and environmental influences as the factors that affected wool quality. The Mbewuleni village was affected by drought that led to poor vegetation in the area, with sheep not getting quality or nutritious feed. A good quality feed has a positive impact on the growth rate and quality of the fleece.

Wool yield was not affected by both t age and sex of the sheep. There is increasing evidence that genetic parameters of lifetime wool production varied with age and sex. The heritability of adult fleece weight was significantly higher than the heritability of younger fleece weight (Clarke *et al.,* 1999). The interaction of village and sex resulted in significant differences in the crimp length (males had higher values) whereas that of village and age did not affect the yield and crimp length. This observation agreed with the findings reported by Tariq *et al,* (2013), that location of flocks at different environments had a significant effect on wool quality.

4.6 Conclusion and recommendations.

It is concluded from this study that age, sex and weight were the factors that affected wool production (quantity and quality). It is also concluded that sheep from the bush encroached site were bigger in size and they produced more kilograms of wool on average compared to those form non encroached site. However, no evidence was found for effects of sex on wool quantity. The other influential factor found was that of age. Older sheep producing relatively more wool. Quality on the other hand was shown to be dependent on locality across all parameters with exception of the comfort factor. Clean yield was surprisingly higher in encroached as compared to non-encroached site. This could be caused by different in quality of grazing in the two villages. The factors of sex and age did not affect the clean yield.

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Chapter 5

5.1 General discussion, conclusion and recommendation

Sheep production plays a major role as it act as source of feed and is very important to the communal farmers (Saico and Abul, 2007). Sheep productivity in the communal areas is affected by several constraints which is parasites prevalence, diseases, poor management, poor housing, breeding employed, feed shortage especial during winter month (Mapiliyao, 2010). When aiming at practical application of sustainable sheep production, it is essential to initially assess the production practices, and the way in which farmers perceive constraints that weaken sheep productivity and establish the major cause of lamb mortality (Mahanjana and Cronjé, 2000).

Developed sheep productivity offers several profits to the communal farmer, which may lead in getting improved earnings. The nutritious status is of vital prominence to know the features and characteristics of communal farmers and communal farming systems in order to come up with viable progressive plan. The information engendered will assist in the understanding of the authentic involvement of sheep to household economy rather than identifying constraints to sheep productivity in isolation (Mahanjana and Cronjé, 2000). The essential roles of the different functions and products from sheep differ by locality, constraints, environmental, production techniques, traditional values and socio-economic status of the household (Kosgey *et al.,* 2008).

5.2. Demographics

Most of the households from both villages were found to be headed by males, which is a common occurrence in the rural areas of the Eastern Cape. This is also the case with the dominant age group, which are mostly pensioners who are married. It is therefore apparent that famers are also unemployed and also relatively uneducated.

5.3. Management practices.

The most prominent production system is extensive farming. In this system the sheep are allowed to graze in the community grazing area during the day and are kraaled at night (Mvinjelwa *et al.*, 2014). Communal farmers prioritise feed during certain periods. Uncontrolled breeding is the breeding system employed in most communal areas in the Eastern Cape Province. It has been observed that most of farmers across the two villages select rams from their flock. They consider physical characteristics, age and indigenous.

5.4. Sheep Dynamics.

The sheep dynamics indicate that bush encroachment is a significant factor with the sheep numbers being relatively larger in the non-encroached site. These higher numbers are also substantiated by the fact that the same village has a higher number of ewes. There was however no conclusive evidence to suggest that bush encroachment has an effect on disease occurrence. The management practices employed in both villages are the same and therefore most of the differences in sheep dynamics can be credited to site specific conditions such as climate and socio-economics.

5.5. Wool quantity and quality.

The encroached site unexpectedly produced more wool, an observation which can be explained by the fact that the site had relatively bigger sheep. The age and body condition score also showed a positive relationship with wool yield. This was also observed by Harizi *et al*. (2015) and Mvinnjelwa *et al.* (2014). Khan *et al.* (2010) on the other hand found that fleece weight decreased with age. The wool quality parameters were influenced in different ways by different factors. As observed by Tariq *et al.* (2013) this study also showed that different environments result in wool of different quality. The influence of sex and age was also evident. There results of this study agreed with findings of Clarke *et al*. (1999) that older sheep have high fleece weight heritability.

5.6. Conclusion

The study reveal that, the average weight of wool from the encroached site is greater than that from the non-encroached site, thus could be caused by the fact that sheep from encroached site were bigger in size compared to those from non-encroached site. There was no statistical evidence to conclude that the average amount of wool obtained from male sheep was greater than that of females though males were produced a little more wool than females. This implied that the sex of the sheep did not affect the quantity of wool produced. The age of the sheep was shown to be a factor in that the quantity of wool produced by 6 teeth sheep was significantly higher as compared to that produced by 4 teeth and 2 teeth sheep, respectively. It has been observed from other studies that the heavier sheep the more wool produced. It was evident from the result that locality (village) had an effect on all parameters (average means for mean fibre diameter, clean yield, crimp, crimp length, and diameter) except of comfort factor.

5.7. Recommendations

A good grazing management system for a communal area is important for the effective development of farmers on communal grazing areas. It is advisable for farmers to make right financial decisions based to the cost of reproduction, flock distribution, production, health, feeding, housing and breeding in order to be successful. A lack of formal education and farming training in livestock/animal husbandry has a negative impact on management skills, and farmers' knowledge about farming. It is advisable that farmers must attend farming management training and have technical support.

Farmers in the communal areas should be assisted in improving their animal farming practices and basic training skills. The enhancement and management practices in rural areas could include training that builds on local knowledge as well as suitable applicable current skills. This may lead to developing attraction of livestock keeping even to communal youth. Biological characteristics (yearling and mature weight) of the non-descript sheep breed indicate that their marketplace value may not be as high as that of other sheep breeds which have higher live body weights. Though, they are adapted to the local environment and the fact that the efforts of farmers is marginal, makes it more worthy when equated to the commercial sheep breeds that require extensive inputs. Local sheep breeds can survive by utilizing only locally available feed resources without major supplements, vaccines and dipping. These animals are productive under local conditions. This is a very important trait for rural livestock production. A small improvement in terms of supplements in the dry season might yield significant positive changes in growth parameters such as live weight gain.

It is recommended that studies be conducted to look into the growth rate of wool in different seasons so that farmers can be advised to adjust their management practices in a way that will ensure that maximum growth rates are obtained. Such management practices could include not allowing the sheep to graze in open fields where the wool can incur damage resulting in reduction in quality. The type of local feed that is best suited to wool production should also be the subject of future studies. The influence of bush encroachment on the physiology and reproduction of the sheep is a subject that the current study did not explore and it is therefore recommended that such studies be conducted as they could shed light on such issues since it has been observed that a bush encroached area can produce more wool.

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Appendices

1. Questionnaire.

University of Fort Hare

Together in Excellence

Questionnaire Title: Sheep flock structure, dynamics, management practices and wool production under bush encroached and non-encroached areas of the Eastern Cape, South Africa

By

Kom Lubabalo

<u>Information</u>

Enumerator name………………… **Municipality ……………………**

District name………………. **Village name…………………**

Date…………………… **Questionnaire number………**

- **FARMER INFORMATION**
- **Demographic information**
- **Sex: 1.M (__) 2.F (__)**
- **Marital status: 1.Married (__) 2.Single (__) 3.Divorced (__) 4.Widowed (__) 5. Other (__)**

- **Age: 1. ≤ 20 (__) 2. 21-30(__) 3.31-40 (__) 4. 41-50(__) 5.51-60 (__) 6. ≥61 (__)**
- **Employment: 1.Employed (__) 2.Unemployed (__) 3.Dependent (__)**
- **Source of income: 1.Salary/Wage (__) 2.Pension (__) 3.Other (specify)……………..**
- **Level of Education: 1.Primary (__) 2.Secondary (__) 3.Tertiary (__)**

LIVESTOCK INFORMATION

- **Why do you keep sheep?**

Reason	Tick	Comment
1. Wool production		
2. Meat consumption		
3. Form of raising income		
4. For investment		
5. Manure		
6. Social-Cultural functions (specify)		
7. Pride & status		
8. Others (specify)		

- **What type of animals do you keep?**

	Animal	Numbers	Breed
1.			
2.			
3.			
4.			
5			

- **Composition of sheep flock**

Class	Number
Ram	
Ewe	
Wither	
Lamb	
Total	

- **Who is the owner of the sheep? 1.Father (__) 2.Mother (__) 3.Children (__) 4.Other (Specify)………………….**

- **Source of sheep: 1.Bought (__) 2.Exchanged (__) 3.Inherited (__) 4.Stud breeder (__) 5.Others (specify)...**

<u>Health management</u>

- **How do you handle your sheep during health management?…………………………………………………………………………… …………………………………………………………………………………………… …………………………………………………………………………………………… ……………………………………………………**

- **Do you experiencing mortality in your breeding flock? 1.Yes(__) 2.No (__)**

- **What is the possible cause of mortality?**

1.
2.
3.
4.

- **What are the common diseases that affect sheep in the area?**

Diseases/conditions	**Occurrences (Summer, Autumn, Winter, Spring) indicate)**
1	
2	
3	
4	
5	

- **Severity**

Disease/ challenge	**Severe**	**Moderate**	**Not severe**
1			
2			
3			
4			
5			

- **Do you dip your flock? 1.Yes(__) 2.No (__)**
- **What is the dipping frequency?**

During summer per month	**During winter per month**
1. Fortnightly (__) 2. Monthly (__)	**1. Fortnightly (__) 2. Monthly (__)**

- **Do you dose your sheep? 1. Yes (__) 2. No (__)**
- **What is the dosing time?**

1.Before raining period (__)	**2.Beginning of raining period (__)**	**3.Mid raining period (__)**	**4.Post raining period (__)**

Breeding management

- **What type of sheep bred do you keep?**
  1. Indigenous breed (___) 2. Exotic breed (__) 3. Other(specify) (__)

- **Which breed do you prefer? 1. Indigenous breed (__) 2. Exotic breed (__) 3. Other (specify) (__)**
- **What are reasons for your choice?**

Reason	**Tick**	**Comment**
1. Wool production (quantity and quality)		
2. Meat quality		
3. Diseases resistance		
4. Availability		
5. Colour		
6. Other(specify)		

- **What is the breeding system? 1. Flock mating (__) 2. Group mating (__) 3. Artificial insemination (__) 4. Other (specify) (__)**

- **What type of breeding employed? 1. Cross breeding (__) 2. Inbreeding (__) 3. Line breeding (__)**

- **What is the mating time do you employ? 1. Continuous mating (__) 2. Autumn mating (__) 3. Spring mating (__)**
- **What is the lambing period do you employ? 1. Autumn lambing (__) 2. Spring lambing (__) 3. Continuous lambing (__)**
- **Management of ewe during lambing: 1. kept on the yard (__) 2. Allowed to go to grazing area with other sheep(__)**
- **What is the weaning type do you employ? 1. Gradual weaning (__) 2. Natural weaning(__)**
- **What is the weaning method do you employ? 1. Age 2. Weight (__)**
- **How do you select your ram? 1. Breed character such as local pure breed (__) 2. Physical character (__) 3. Age (__)**
- **What is your source of rams: 1.purchase (__) 2. Community ram (__), 3. Breeding flock (__)**
- **How do you select your ewe? 1. Color (__) 2. History performance (__) 3. Horn shape (__) 4. Body conformation (__) 5. Tail length (__)**

Feeding and housing management

- **What is production system do you employ? 1. Extensive (__) 2. Intensive (__)**
- **Division of activities by different members (men, woman, boy, girl and worker), 1. Owner of flock (__) 2. Feeding of the flock (__) 3. Watering (__) 4. Health care of the flock (__)**
- **Where is the source of feed? 1. Community grazing (__) 2. Road side grazing (__) 3. River side grazing (__) 4. Supplementation (__) 5. Crop residue (__)**
- **Ways of grazing: 1. Sheep graze separately (__) 2. Sheep mixed with other livestock (__)**
- **What source of water do you have for animal watering? 1. Borehole (__) 2. Dam (__) 3. River (__) 4. Windmill (__) 5. Others (Specify)………**

- **Do you experience feed shortage? 1. Yes (__) 2. No (__)**

- **If yes, how do you prioritise feeding during feed shortages? 1. Feed ewe (__) 2. Feed ram (__) 3. Feed lamb (__) 4. Feed weaners (__) 5. Feed wither (__)**

- **Do you supplement your flock? 1. Yes (__) 2. No (__)**

- **What class of animal do you supplement? 1. Ewe (__) 2. Ram (__) 3. Wither (__) 4. Lambs (__)**

- **What is type of supplement? 1. Pellets (__) 2. Crip-feed (__) 3. Maize (__) 4. Lamb tubes (__) 5. Other (__)**

- **Reason for supplementing your flock**

____
____
____
____

- **What measures are you putting in place to address the problem?**

1
2
3
4
5

- **Housing 1. Open kraal (__) 2. Shelter (__)**
- **Animal separation 1.Yes (__) 2. No (__)**
- **What material you used in building your kraal?**

____

____

❖ **How many kraals you have for breeding flock?**

Flock dynamics recording sheet.

Name of the farmer: …………………………… Name of the enumerator:

………………...

Location: ………………………… Date: …………………………..

Flock composition	**Number**	**Comment**
Lambs (Amatakane)		
Young rams (amaduna)		
Young ewes (Amathokazi)		
Withers (Iinkatyana)		
Mature castrates (Iinkabi)		
Ewes (Iimazi)		
Mature Rams (Iinkunzi)		
Total		

In-takes	**Number**	**Comment**
Births (Ezizelweyo)		
Entrusted-in (Ukunqoma)		
Gifts-in (Izipho)		

Purchases (Ezithengiweyo)		
Exchange-in (Ukutshintshisa)		

Off-takes	Number	Comment
Sales (Ezithengisiweyo)		
Gifts-out (Ekuphiswe ngazo)		
Slaughtered (Ezixheliweyo)		
Exchange-out (Ekutshintshiswe ngazo)		
Entrusted-out (Ukunqonywa)		
Mortality (Ezifileyo)		
Predated upon /stolen/lost (Ezibelixhoba/Ezebiweyo/Ezilahlekileyo)		

- **WOOL QUALITY AND QUANTITY**

Wool weight	Crimp length	Fineness	Fibre diameter	Fibre length	Clean wool	kg's of wool per sheep	Overall kg of wool per flock

- **WOOL PRODUCTION.**

Year	Production (kg of wool)	Wool price (Rands)	Gains (Rands)

2011			
2012			
2013			
2014			
2015			

❖ **Where do you sell your wool?**

❖ **Do you grade your wool?**

Yes		**No**	

❖ **How grading is done?**

❖ **Who perform grading?**

❖ **What criteria is used to do grading?**

❖ **How much quality per grade?**

❖ **How many times do you shear your sheep per year?**

Once		**twice**	

❖ **When is your shearing time?**

2. Ethical clearance certificate.

ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number:	MUP071SKOM01
Project title:	**Sheep flock structure, dynamics, management practices and wool production under bush encroached and non-encroached areas of the Eastern Cape Province, South Africa.**
Nature of Project:	Masters
Principal Researcher:	Lubabalo Kom
Sub-Investigator:	N/A
Supervisor:	Prof J.F Mupangwa
Co-supervisor:	N/A

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

Special conditions: Research that includes children as per the official regulations of the act must take the following into account:

Note: The UREC is aware of the provisions of s71 of the National Health Act 61 of 2003 and that matters pertaining to obtaining the Minister's consent are under discussion and remain unresolved.

Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 6 June 2013, university ethics committees may continue to grant ethical clearance for research involving children without the Minister's consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office

The Ethics Committee wished you well in your research.

Yours sincerely

Professor John Fisher Mupangwa
AREC-Chairperson

05 May 2016