Some performance characteristics of woolled sheep in the sweet and sourveld communal rangelands of Eastern Cape Province, South Africa

By

Mvinjelwa, Sivuyile Alex

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Department of Livestock and Pasture Science

Faculty of Science and Agriculture

University of Fort Hare

P/Bag X1314

Alice

5700

South Africa

University of Fort Hare

Together in Excellence

Supervisors:

Dr. M. Mapekula

Dr. V. Maphosa

Prof. V. Muchenje

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Declaration

I, the undersigned, declare that this dissertation has not been submitted to any University and that it is my original work conducted under the supervision of Dr. M. Mapekula, Dr. V. Maphosa and Prof. V. Muchenje. All assistance towards the production of this work and all references contained herein have been duly accredited.

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Sivuyile Alex Mvinjelwa **Date**

Approved as to style and content by:

__________________ _____________________ _____________________

Dr. M. Mapekula **Dr. V. Maphosa** **Prof. V. Muchenje**

November 2013

Abstract

Performance of woolled sheep in the sweet and sourveld communal rangelands of Eastern Cape Province of South Africa

By

S.A. Mvinjelwa

The objective of the study was to determine sheep growth performance, fleece weights and wool quality characteristics in the sweet and sourveld communal rangelands of the Eastern Cape Province of South Africa. Data were obtained in 80 ewes aged two to three years, selected in four ecologically different communities. Two communities (Roxeni and Tyabane) were in a sweetveld area and the other two communities (Luzi I and Luzi II) were in a sourveld area. The ewes from Tyabane were nondescript, whereas ewes from Roxeni, Luzi I and Luzi II were crossbred between Merinos and non-descript sheep. Selected ewes were monitored for live weight, body condition scoring and fleece weight during shearing. Wool samples were collected from each ewe and were analysed for fibre diameter, comfort factor, clean yield, wool crimps, staple length, staple strength and the Position of break. Sheep from Roxeni were heavier (P <0.05) (39.9 ± 1.1kg) than sheep from Tyabane (29.8 ± 1.1kg). Sheep from Tyabane had the lightest (P <0.05) fleece weight (1.0 ± 1.1kg) and sheep from Roxeni had the heaviest (3.1 ± 1.1kg). There were no significant differences (P ≥0.05) between body condition scores of sheep in Roxeni and the Luzi communities. The live weights of the two-year old ewes were similar (P ≥0.05) to the three-year old ewes' live weight. However, the three year old ewes had higher (P <0.05) body condition scores than the two year old ewes. Two year old ewes also had lower (P <0.05) fleece weight than the three years old ewes.

Wool from Roxeni, Luzi I and Luzi II had lower fibre diameter (P <0.05) than wool from Tyabane. Roxeni sheep had the highest clean yield (P <0.05) of wool, followed by Luzi I and Luzi II; Tyabane had lowest clean yield percentage of wool. Wool from sheep grazing on sweetveld had a higher (P <0.05) clean yield percentage (74.3 ± 0.7%) than those grazing on sourveld (71.7 ± 0.7%). There were higher staple mid-breaks (69.5 ± 5.2) and lower base-breaks (30.5 ± 5.2) in sweetveld (P <0.05) than in sourveld, 7.5 ± 5.2 and 92.5 ± 5.2 for mid-breaks and lower base-breaks, respectively. It was concluded that sheep raised in the sweetveld and bred with purebred Merino rams had higher performance than the ones reared in the sourveld. The young upgraded ewes had a higher wool quality than the older ewes raised on communal rangelands.

Key words: Age of ewes, body condition score, live weight, communal areas, fleece weight, sourveld, sweetveld, veld type, wool characteristics.

List of Abbreviations

ANOVA: Analysis of variance

LW: Live Weight

BCS: Body Condition Score

CWSA: Cape Wools S.A. South Africa

DRDAR: Department of Rural Development and Agrarian Reform

FW: Fleece Weight

NWGA: National Wool Growers Association

PDIFF: Predicted Difference

POB: Position of Break

SAS: Statistical Analysis Systems

SAWAMBA: South African Wool and Mohair Buyers Association

UFH: University of Fort Hare

WTB: Wool Testing Bureau

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I dedicate this study to my forefathers (Jafta and his son Joseph) my late great grandparents (Richard Gxadavu and Mamaduna Mvinjelwa), my grandparents (David Mhase and Nomana Mvinjelwa), my lovely parents (Zulu Square and Nosicelo Cece) my sisters and brothers (Nomzamo, Nosithembiso, Bongeka, Zandiswa, Abongile and Aviwe), my nephews (Onika, Liminathi, Likanye and Yiva), my father's brothers and sister and their children (Mxolisi Makhamandela, Mawethu Tanana and Bhaselwa) the rest of Mvinjelwa and Sidondi family and also to my fellow church mates at Last Move Ministries. This is a result of your motivation, assistance and your prayer messages. I wish to leave you with a message stating that with God everything is possible.

CHAPTER 1: Introduction

1. Introduction

1.1 Background

The Eastern Cape Province is well-known for its high livestock numbers; these include cattle (3097000), sheep (8363000), goats (295121), pigs (282931) and poultry (Department of Agriculture, Forestry and Fisheries, 2012), but the cattle, sheep and goats are dominant (Mapekula, 2009). This indicates that this province has the potential for livestock production. Although livestock numbers dominate in this province, the income generated from livestock is low, and, as a result, the province is still graded as the poorest province among the nine provinces in South Africa (National Department of Agriculture, 2004). Yet, provincial leaders do not see livestock production as an area that needs to be developed. Sheep, for instance, are among the more extensively managed livestock that have received little welfare attention, since they are seen as pastoral creatures (Fayemi and Muchenje, 2013).

However, global wool production is approximately 1.3 million tons per year, of which 60% goes into apparel. Australia is the leading producer of wool, mostly from Merino sheep, and New Zealand is the second-largest producer of wool (Smith *et al*., 1997). Wool production in South Africa is currently about 45 million kg per annum (Department of Agriculture, Forestry and Fisheries, 2011; De Beer, 2012). Communal and emerging wool farmers produce 12% of the national clip and are mainly located in the former homelands of the former Transkei and Ciskei in the Eastern Cape, as well as Thaba Nchu and QwaQwa in the Free State Provinces. These areas produce only 4 million kg of wool annually, of which 2.3 million kg is marketed through brokers at formal auctions (Eastern Cape Department of Agriculture, 2008).

In South Africa, wool-sheep are produced throughout the country, with a larger proportion coming from harsh, low-rainfall (sweetveld) areas, like the Karoo, than from the higher rainfall (sourveld) areas of the coastal belt and the Highveld (Mapiliyao *et al*., 2012). Wool is the primary product of sheep farming in the Eastern Cape with higher quantities in Queenstown and Whittlesea (National Wool Growers Association, 2011). Opportunities exist for wool producers to partner with the wool grower associations to provide support structures to this industry by way of shearing facilities, transport solutions and access to global markets (Eastern Cape Development Corporation, 2011).

The Eastern Cape Province consists of sweet- and sourveld regions (Tainton, 1999). The rangeland constitutes a valuable, yet inexpensive, resource (Scogings *et al*., 1999). Sweetveld areas have a high potential for wool production, because wool sheep perform better in those areas. Therefore, it is important for the government to make use of this opportunity to create more jobs.

The National Wool Growers Association (NWGA) initiated a breeding scheme project in the communal farming areas of Eastern Cape Province to improve these communal sheep flocks. This project started in August 2002 with the identification of 16 communities by the committee members of the NWGA. The outline of the project consists of an annual supply of 3000 rams to communal farmers and an evaluation of the impact of these rams through the execution of progeny tests (Marais, 2005). The NWGA's Training and Development for Communal and Emerging Wool Farmers program aims to pool resources and establish on-going mentorship. Since 1997, the program has helped to increase the bale volumes from just over 222 000 kilograms in 1997 to 2.9-million kilograms in 2010 (De Beer, 2011).

1.2 Problem Statement

The quality and quantity of wool per sheep produced by communal sheep farmers of the Eastern Cape is low, resulting in low returns. This is seen in the fact that wool produced by communal farmers are set at lower prices than wool produced by commercial wool producers (National Wool Growers Association, 2011). Performance of communal wool sheep in the Eastern Cape is poor, with an average amount of 2-3 kg of wool per sheep, compared to the 3-5 kg per sheep in commercial production (Makapela, 2008). Wool has a great profit potential for wool-producing farmers, and it can improve the farmer's income (De Beer, 2011); however, farmers in the Eastern Cape still find it difficult to explore this potential. Therefore, it becomes imperatively necessary to investigate this gap.

1.3 Justification

The Eastern Cape is known for its diversity in terms of veld types such as sweetveld, mixed-sweetveld, sourveld and mixed-sourveld. Moreover, the Eastern Cape Province has the highest sheep numbers and is the leading Province in wool production. Although wool production is the dominant enterprise in this Province, their revenue does not contribute to the economy as this Province is still the poorest. This shows a need to evaluate the sheep and wool quality of the communal farmers of Eastern Cape in different rangelands. This will reveal challenges that prevent the communal farmers from producing more profitable wool.

1.4 Aim of the Study

The aim of this study was to evaluate the potential of communal wool farmers of the Eastern Cape to produce quality sheep and wool under sweet and sourveld communal rangeland conditions.

The objectives of this study were to:

- Determine the effect of community, veld type and age on growth performance and fleece weight of communal sheep that are managed differently.

- Determine the effect of community, veld type and age on wool quality of communal sheep that are managed differently.

1.5 Hypotheses

The communal rangelands have no potential to produce quality sheep and wool under sweet and sourveld communal rangelands.

Community, veld type and age have no effect on sheep growth performance, fleece weight and wool quality of sheep that are managed differently.

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CHAPTER 2: Literature Review

2.0 Introduction

South Africa's black smallholder farmers have begun to find their feet in the tough environment of commercial farming, with successful stories being recorded in the Eastern and Northern Cape Provinces (Grwambi, 2005). The majority of the 17 000 wool sheep smallholder farmers living in the former Transkei and Ciskei regions are located to the north and south of the Kei River in the Eastern Cape. These smallholder farmers run herds of 20 to 30 sheep on average. These farmers use to struggle to make sustainable living, but the mentorship and support programme offered by National Wool Growers Association (NWGA) have been of assistance to the farmers. The farmers are now serious players in the wool export industry (National Wool Growers Association, 2011).

The NWGA's Training and Development for Communal smallholder wool farmers programme aims to pool resources and establish on-going mentorship (De Beer, 2011). The programme has made a huge difference to the income and overall social status of the farmers (De Beer, 2012). The rand value for the communal areas in 2010/11 season is estimated at almost R70-million, of which 90% is earmarked for export. With the help from the NWGA, participating smallholder farmers of Eastern Cape have gradually been building up the genetic quality of the local herds with superior Merino breeding rams (Grwambi, 2005). Genetic improvement has brought about significant change to the quality of the wool produced and the quality of life in the area (De Beer 2011).

To ensure continued success of both commercial and communal wool farmers, it is more important that the animals with the highest profit per hectare are identified than those with a high profit per head. This will, therefore, result in selection of animals that will increase profit of a wool farming enterprise per hectare. Moreover, it will ensure an optimal production of wool and mutton by the wool and meat industries of South Africa without pressurising the natural resources (Olivier, 2009). In 2011, the national price of wool was R104/kg, one sheep can produce approximately 4kg once a year, making an income of R416 a year (Department of Agriculture, Forestry and Fisheries, 2011).

2.1 Growth performance of sheep

According to Mapiliyao *et al*. (2012), improvement in sheep performance offers opportunities for most resource-limited farmers to earn better returns in cash and to improve nutritional status. The driving forces for changes in sheep production systems operate at different aggregation levels, because agro-ecological conditions have an impact on the availability of feed and the prevalence of diseases/parasites. Wool production increases with age and it declines less rapidly after four years as the sheep grow older (Rose and Pepper, 1999).

2.1.1 Fleece weight

This is the coat or yield of wool shorn from a sheep at one time. Once the entire fleece has been removed from the sheep, the fleece is thrown, clean side down, onto a wool table (Terry and Hough, 2010). The average fleece weight per commercial sheep is 4 to 5kg, while it is only 2 to 3kg per communal sheep (Makapela, 2008). High fleece weight increases the relative economic value of fleece and it is associated with younger and lighter animals (McGregor, 2006). According to Marais *et al*. (2010), the average greasy fleece weight of a commercial 6 months old lamb is higher (2.8 kg) than a communal lamb of the same age (2.4 kg). Age, inbreeding, age at shearing and type of birth affect the fleece weight (Terrill *et al*., 1948; Khalid *et al*., 1953).

2.1.2 Body Condition Score and live weight

Sheep producers must understand the body condition scoring of the sheep. During the course of the production cycle, sheep producers in communal areas must know condition of their sheep. This include either being too thin, too fat, or just right for the sheep's stage of production, like late pregnancy and lactation (Mapiliyao, 2010). The absolute effects of body condition score and live weight have a great impact on sheep reproduction efficiency. Ewes with a moderate body condition score have a good reproduction performance; however, fat or obese ewes usually experience dystocia (Mapiliyao *et al*., 2012; Aliyari *et al*., 2012). Sheep with a higher body condition score are commonly found in the sweetveld.

Body condition scoring is convenient and much more accurate than a simple eye appraisal (Mapiliyao, 2010). The body condition scoring has been used by many authors to determine nutritional status of livestock (Ndlovu *et al*., 2007). Scoring is based on the sensation of the level of muscling and fat deposition over and around the vertebrae in the loin region (Russel, 1991). Seasonal variation is a key factor in communal areas where extensive management of sheep is directly linked to the environmental conditions (Mapiliyao, 2010). Live weights should be at least 40 kg for medium wool Merinos and 45 kg for crossbreds. Sheep with higher live weights are found mostly in sweetveld areas.

2.2 Veld types of the Eastern Cape communal rangeland

The Eastern Cape constitutes both sweetveld and sourveld (Tainton, 1999). The production potential of these pastures is variable and depends mainly on the amount and distribution of rainfall, soil depth and soil type (du Toit Moolman and Burger, 1992). The rangeland constitutes a valuable, yet inexpensive, resource (Scogings *et al*., 1999; de Bruyn, 2000). De Bruyn (2000) stated that utilizing rangelands in a sustainable manner is the social responsibility of the land users, although concepts such as soil erosion and maintenance of biodiversity have very little emotional appeal.

2.2.1 Sweetveld

The sweetveld is generally regarded as palatable fodder and is associated with clay soils (du Toit Moolman and Burger, 1992). The sweet grassveld are tufted climatic-climax grasslands and is largely controlled by climate. The semi-arid grasslands are typified by an extremely variable rainfall, both within and between years (Tainton, 2000). Annual dry matter production therefore varies considerably from year to year and from season to season (Van Niekerk, 1994).

Sweetveld rangelands are known to be prone to degradation. Degradation of sweet grassveld may be associated with a reduction in basal cover, which is associated with decreased infiltration and increased runoff, resulting in an increase in less productive pioneer grass and woody species, including *Acacia*, *Chrysocoma*, *Pentzia* and *Fecia*. Dominating grass species are *Themeda triandra and Cymbopogon plurinodis* (Tainton, 2000). The risk intrinsic to livestock production from veld is extremely high in these areas, particularly where over-stocking rates are used. The spring period is typically the most critical in providing adequate feed for livestock, as spring rainfall is normally relatively poor and is particularly unreliable (Tainton, 1999).

Forage quality in sweet grassveld is higher than in sourveld and remains fairly uniform throughout the year. The digestibility of the ingested forage may range between 56% and 60% in summer, but decreases to between 46% and 57% in winter (Danckwerts *et al.*, 1989). Crude protein content of herbage may vary between 2% and 6%, while protein intake may range between 8% in winter and 13% in summer. Growing stock tends to maintain condition during the winter and may continue to gain mass. Where woody species have invaded, the incorporation of browsers, such as goats, into the system may considerably increase production (Tainton, 1999).

2.2.2 Sourveld

Sourveld usually occurs on deep, sandy soils and become less palatable and less nutritious during mid- to late summer (du Toit Moolman and Burger, 1992). There is a potential for woody vegetation to develop in the absence of fire so that in its absence most of the sour grassveld are replaced by scrub or forest (Tainton, 1999). Typically, spring growth in sour grassveld is highly palatable and its quality is generally sufficient to sustain high levels of reproduction and growth. However, palatability and feeding value decline rapidly as the plant matures, particularly where the rainfall is high, since the grasses tend to mature early in the growing season (Mapekula, 2003).

Under conditions of frequent fire and low grazing pressure, sour grassveld is generally comprised of *Themeda triandra* dominated communities (Trollope, 1983). However, increased grazing pressure due to the introduction of livestock and perhaps a changed frequency and intensity of fire has resulted in changes in the community composition and structure of these grasslands. High grazing intensity leads to a loss of palatable species such as *T. triandra*, which are replaced by grazing tolerant, unpalatable species such as *Eragrostis curvula, Eragrostis plana, Sporobolus africanus and Sporobolus pyramidalis* (Tainton, 1999). Rotational grazing and suitable stocking density should be always prioritized. Reasonable burning or grazing in sourveld is required to secure the veld from undesirable species.

2.3 Wool production in South Africa

Wool is produced throughout South Africa, but the main wool production areas are the drier regions of the country (Department of Agriculture, Forestry and Fisheries, 2011). On a provincial basis, the Eastern Cape is the largest wool-producing region, producing 25.1% of the national clip, followed by the Free State with 24.1%, Western Cape with 19.9%, Northern Cape 12.5% and Mpumalanga with 7.7% (National Department of Agriculture, 2000). In total, wool production in South Africa is currently about 45 million kg per annum (De Beer, 2012).

Australia remains the largest supplier of apparel wool to the world textile market, with an estimated production of 626 million kg (greasy) in 1999/2000 (Cape Wools S.A., 2002). South Africa, like Australia, produces mainly apparel wool, while the bulk of the production of the other major wool producers, like New Zealand and Argentina, is coarse wool. The coarse wool is used for the production of carpets and blankets. Wool's main competitors are man-made fibres such as polyester, nylon and acrylic (National Department of Agriculture, 2011). Apparel wool is defined as wool of 30 microns and finer in diameter, which is used in clothes manufacturing. Finer fibres produce yarns with a more uniform texture and greater strength and softness; these result in an inverse relationship between fibre diameter and price (Beare and Meshios, 1990). There is normally considerable volatility in wool prices during and between auctions (National Department of Agriculture, 2000).

2.4 The wool industry

Currently, the wool industry is composed of producers, organizations, associations, buyers and processors, traders and brokers, as well as the Wool Testing Bureau (WTB). Wool producers are the commercial and communal farmers from all over the country. The organizations are the

National Wool Growers Association, situated in Port Elizabeth, and Wool South Africa in Somerset East (National Department of Agriculture, 2011). These organizations provide advisory services, training and development to the wool producers (farmers). The associations are Cape Wools S.A. of South Africa (CWSA) and Wool and Mohair Exchange of South Africa (WMESA) and both are situated in Port Elizabeth. These associations have been mandated by the Department of Agriculture, Forestry and Fisheries to provide market information and statistics for wool production to researchers, farmers and other interested persons or organizations (Nkonki, 2006).

The wool traders and brokers are *Boere Korporasie Beperk* (BKB), Bruce, Lappersome and Saunders, and Cape Mohair and Wool (CMW). They are all situated in Port Elizabeth. The wool traders buy and sell raw wool from farm organizations or from individual farmers and later sell it to processors. There are also wool buyers and processors in Port Elizabeth and in Durban. Some wool buyers in Port Elizabeth are Lempriere, Standard wool South Africa, New England Wool South Africa, Chargeurs Wool South Africa, Stucken and Co. These companies buy raw wool from farmers, process it and sell it worldwide (Department of Agriculture, Forestry and Fisheries, 2011). Lastly, the Wool Testing Bureau, which is also situated in Port Elizabeth, is responsible for screening traces of contamination in wool by vegetable matter content. If the wool is contaminated, appropriate measures are automatically taken to rectify the matter. The wool industry in South Africa is unstable; this was shown when wool production increased slightly from 45.4 million in 2003/2004 to 46.5 million in 2004/2005 (Nkonki, 2006).

2.5 Wool channelling

The wool industry is one of the oldest agricultural industries in South Africa (Brand and Aucamp, 2000; Makapela, 2008) and it plays an important economic role as an earner of foreign exchange for the country, and provides employment to 250 000 people. South African wool is largely an export commodity, in both greasy and semi-processed form. Most of the clip is marketed internationally through members of the South African Wool and Mohair Buyers Association (SAWAMBA) (Grwambi, 2005).

A larger proportion of the South African wool clip comes from the harsh, lower rainfall areas than from higher rainfall areas of the coastal belt and the Highveld. The Eastern Cape produces about 24 % of the national clip (National Department of Agriculture, 2000). The commercial farmers in South Africa are the largest suppliers of wool (Nkonki, 2006). Wool channelling for smallholder farmers in the former Transkei of the Eastern Cape differs from that of commercial farmers. D'Haese *et al*. (2003) identified the following three options for wool channels that exist for small-scale farmers:

- The small-scale farmers may organize their own shearing and sell the wool directly to brokers.
- Alternatively, they may shear the sheep themselves at their homes and sell individually to local traders or to brokers who buy unsorted wool at the farm gate. Local traders are often local business people who pay low prices to wool producers (speculators). Local traders and brokers take the wool to processors and make profit from selling it.
- Lastly, members of an association may shear their wool in the community shearing shed, pack the wool collectively, and then sell it to brokers through the shearing shed. The brokers then pay the farmers through the shearing committees, according to wool grades.

Small-scale wool growers who do not operate through shearing sheds have limited marketing opportunities. Their marketing route ends at local traders and occasionally at brokers. Figure 2.1 illustrates wool channels that small-scale and large-scale wool growers follow.

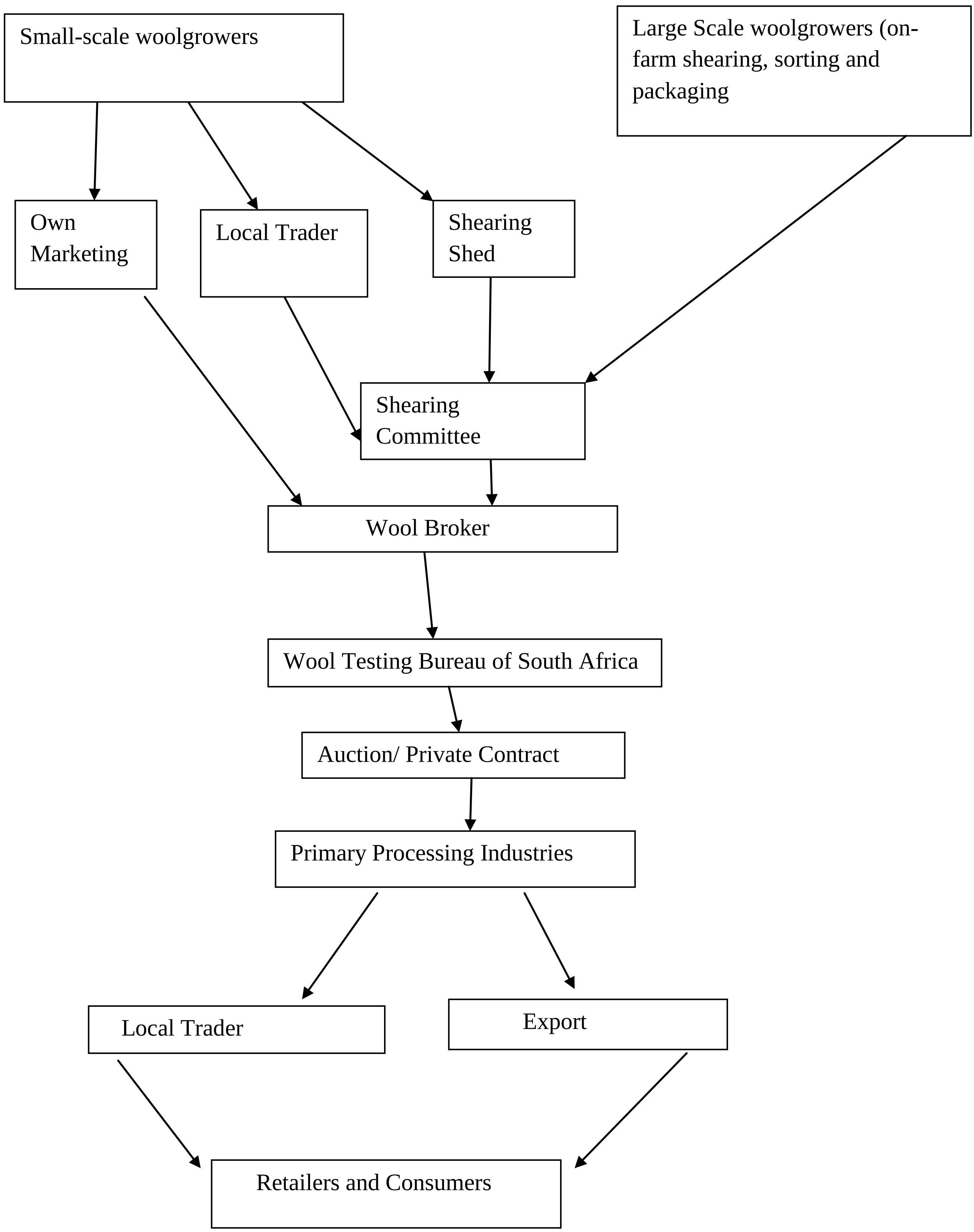

Figure 1.1: Wool channelling for small-scale and large-scale woolgrowers in the former Ciskei and Transkei, Eastern Cape. Source: (D'Hase *et al.*, 2003).

According to National Department of Agriculture (2001), South Africa exports about 85 to 90 % of its wool, and is the world's fifth largest exporter of wool after Australia, New Zealand, Argentina and Uruguay. The main export destinations of wool are countries like Italy, France, Germany, the United Kingdom (UK), Japan, China, Taiwan and the United States of America (USA) (National Department of Agriculture, 2011). The wool destined for the export market is taken to the three South African ports, Port Elizabeth, Cape Town and Durban, which are situated conveniently on one of the world's major shipping lanes between East and West. High-density presses (dumps) are used at all these ports. These dumps allow for compressing bales into a third of their original size, making it possible to pack 96 bales into a $6m^2$ sea containers (Cape Wools S.A., 2002).

2.6 Price of Wool

There is no fixed price for trading wool (National Department of Agriculture, 2001). The price of wool is determined by a complex set of factors. These factors comprise of the level of the market in Australia on a given day, exchange rate fluctuations, quantities offered for sale at auctions and the specific demand for different types of wool at different times (Cape Wools S.A., 2004: Makapela, 2008). For example, during the start of the wool season, the price of wool is higher and drops as the wool season goes by and increases again towards the end of the season. These factors further comprise the extent and timing of contact commitments by local buyers for delivery to the clients and the prevailing economic conditions in wool consuming countries (Cape Wools S.A., 2005; Cape Wools S.A., 2007).

2.6.1 Factors affecting price of wool

The marketing of wool commences from the farm up to the export or auction level. Therefore, there are on-farm factors that affect the price and total income that the producer receives from wool (National Department of Agriculture, 2001), and off-farm factors which also have impact on price of wool (Skinner, 1965).

- **On-farm factors that affect price of wool**

There are factors that affect wool price from the farm to the broker. These include the following: Genetics; these are characteristics inherited by offspring from their parents. The genetic quality of the sheep determines the quality and quantity of wool that sheep produce. Good quality sheep produce better quality and quantity of wool. Lambing percentage; the number of lambs produced per year indicates the number of sheep that can be sheared in the following seasons and excess lambs could be sold for additional income. Feed and grazing quality; better quality feed leads to high feed conversion ratio (HFCR), converting the feed into wool. The better the quality of grazing, the less the possible sources of wool contamination in the veld, and the easier it is to produce good quality wool. Nutrition is moreover required to fully express the genetic characteristics.

Sheep should get quality feed during the growing period and throughout their lifetime (Reis and Sahlu, 1994). Sufficient quality feed, which include water, proteins, vitamins, energy and minerals, results in good performing sheep that would produce more wool. For wool production, there should be essential indispensable amino acids such as cysteine, and methionine. Minerals are required in wool sheep to prevent breakage of wool either in the tips or in the middle (Sahoo and Soren, 2011).

Management; sound management of all the production and marketing activities lead to higher total income for the producer (Grwambi, 2005). During shearing, the shed must be clean from dust, papers and other materials to avoid contamination of wool.

Drought; during drought farmers tend to reduce the non-breeding components of their flocks. Therefore, wool sheep numbers decline resulting to less quantity of wool produced and this increase the wool price due to high demand.

- **Off-farm factors that affect price of wool**

These are factors that affect the price of wool positively or negatively out of the farm, i.e. in an auction or market. These include the following:

Supply and demand: high supply with low demand of wool result in lower prices of wool. However higher demand with low supply of wool results in increase in price. Competition: the competition from other textile fibres, like nylon, cashmere and cotton, results in a decrease of wool price, especially nylon because it is cheaper than wool, so it gains higher demand (National Department of Agriculture, 2001).

Fashion and advertising: when a certain material is in fashion at that particular time, it gains a higher demand albeit at a higher price. Good advertising leads to better returns, thus encouraging more production of wool.

Value of rand: the low value of the rand will increase the price of wool in terms of South African rand (ZAR), although the price in dollar may still be the same. Unfavourable economic conditions: the unfavourable conditions in the buyer countries adversely affect the demand of wool in these countries, thus affecting the price of wool.

Price of other small stock products: A high demand in other products, such as mutton or mohair, will result in a shift in interest of the farmers and consequently in a drop in both wool sheep numbers and wool price (Skinner, 1965).

2.7 Properties of wool

Wool consists of different properties such as durability and resilience, fibre absorbency, dyeability, chemical structure and resistance to compression, which makes it unique from other fibres.

Durability and resilience: Each wool fibre is a molecular coil-spring making the fibre remarkably elastic. Nature has folded the chemical polypeptide chains back upon themselves in such a way that they act like a coiled spring which elongates when it is extended and retracts when it is released. This molecular crimp, along with the 3-dimensional fibre, allows wool fibres to be stretched up to 50% when wet and 30% when dry and still bounce back to their original shape when stress is released (American Wool, 2003; Alpaca Breeders, 2011). Recovery from stress takes place faster when the fibre is in a humid environment, hence the steaming of a wool garment freshen the fabric and thus a steam iron is recommended for pressing wool. The flexibility of the wool fibre also makes wool more durable. A wool fibre can be bent back on itself more than 20,000 times without breaking compared to about 3,000 times for cotton and 2,000 times for silk. The natural elasticity of wool also makes woollen fabrics resistant to tearing. In addition, the outer skin of the wool fibre acts as a protective film, giving wool cloth improved resistance to abrasion (Eastern Cape Department of Agriculture, 2008).

Fibre absorbency: Wool is a hygroscopic fibre that takes up moisture in vapour form. Tiny pores in the epicuticle make the fibre semi-permeable, allowing vapour to pass through to the heart of the fibre. Wool can easily absorb up to 30% of its weight in moisture without feeling damp or clammy.

The capacity to absorb moisture makes wool a ‘temperature regulator’, because it can protect the body in both cold and warm conditions. Wool always absorbs moisture from the atmosphere of greater humidity and releases it to the drier environment as it creates a balance in moisture conditions (Cape Wools S.A., 2009). This characteristic makes wool a versatile all-season fabric. Wool absorbs perspiration; thus it keeps a layer of dry air next to the skin which, in turn, helps to hold in body heat. As wool absorbs atmospheric moisture, the hydrogen bond of water is broken and it chemically reacts with molecules of the wool to generate heat. Wool garments are therefore regarded as good protection against hypothermia, a condition that occurs when a sudden drastic lowering of body temperature causes the body to lose heat faster than it can be produced (The Campaign of Wool, 2009).

Takes dye beautifully: Wool absorbs many different dyes deeply, uniformly and directly without the use of combining chemicals. Wool is amphoteric, meaning it reacts with both acids and bases; thus it accepts both acid and basic dyestuffs. Dyes penetrate into the inner medulla core of the fibre where a chemical reaction occurs making the colour change permanently except under extreme and prolonged fading conditions (National Wool Growers Association, 2011).

Resistance to flame: Because wool contains moisture in each fibre, it resists flame without chemical treatment. Instead of burning freely when touched by flame, wool chars and stops burning when it is removed from the source of fire; therefore, it is self-extinguishing. It will not support combustion; this is why wool blankets are recommended for use in extinguishing small fires (Smith *et al*., 1997).

Chemical structure: Wool is a natural protein fibre that grows from the follicles of the sheep’s skin. It is like human hair in that it is composed of keratin-type protein. Chemically these proteins contain 5 elements: carbon, hydrogen, oxygen, nitrogen and sulphur. These 5 elements are combined into 19 amino acids linked together in ladder-like polypeptide chains (Cape Wools S.A., 2009).

Resistance to compression: Resistance-to-compression values are useful in assessing the suitability of wool for specific end-uses. Resistance to compression (R to C) is the force per unit area required to compress a fixed mass of wool to a fixed volume. Resistance to compression is related to fibre diameter and the form and frequency of crimp. For instance, low and medium R to C wool tends to be softer, more lustrous, more susceptible to felting, easier to process and produce strong fabrics (National Wool Growers Association, 2011). On the other hand, high R to C wools have a harsher handle, are resistant to felting and are bulkier (American Wool, 2003: Eastern Cape Department of Agriculture, 2008).

2.8 Quality attributes of wool

In a wool context, quality is what determines the returns from wool more than the quantity. In most cases, the quality of wool from communal and small scale farmers is much poorer than commercially produced wool (Makapela, 2008). This is reflected by the average communal price of wool which was R18.00 per kilogram in 2011 compared to the R101.00 per kilogram of the national average price (National Wool Growers Association, 2011).

According to the Australian Wool Exchange (2010), the quality of wool is determined by its fibre diameter, crimp, yield, colour and staple strength. The wool quality attributes are discussed below.

2.8.1 Fibre diameter

Fibre diameter is the single most important wool characteristic determining quality and price. Merino wool is typically 3 to 5 inches in length and is very fine between 12 and 24 microns (Cape Wools S.A., 2007). Wool from mutton sheep is typically coarser compared to the wool sheep and has fibres 38 to 150mm in length. Damage or breaks in the wool can occur if the sheep is stressed while its fleece is growing, resulting in a thin spot where the fleece is likely to break. Wool is also separated into grades based on the measurement of the wool's diameter in microns and also its style. These grades may vary depending on the breed or purpose of the wool (Smith *et al*., 1997).

Mean fibre diameter above 23µm and age of sheep above two to three years decreases the relative economic value of wool (McGregor, 2006). Fibre diameter determines the fineness or thickness of the wool. Its profile characteristics vary among environments, bloodlines, sire groups and individual sheep (Brown and Crook, 2005; Greeff, 2006). According to Australian Wool Innovation (2010), mean fibre diameter is a measurement in micrometres (microns) of the average diameter of fibres in a sale lot. The fibre diameter can be judged in relation to age and level of nutrition: the finer the fibre the higher the unit value. Fibre fineness in practice is determined according to the size of the crimp, i.e. the smaller the crimp the finer the wool.

Table 2.1 The fibre diameter classes

Description	NGWA Symbol	Spinning Count	Micron Thickness
Superfine (µm)	FF	70+	Less than 19
Fine (µm)	F	70	19
Medium (µm)	M	64 – 70	19 – 21
Strong (µm)	S	60 – 64	21 – 23
Over-strong (µm)	SS	58 – 60	23 – 25

Source: Cape Wools S.A., 2007.

2.8.2 Wool Crimps

Wool crimp can be defined as the number of bends per unit length along the wool fibre and it approximately indicates spinning capacity of the wool. Fibres with fine crimp have many bends and usually have small diameter (Moule, 1992). Crimp is the multi-dimensional structure and the way it is expressed is determined by genetics, amplitude, frequency and micron. In the wool industry, crimp is considered to be an important factor in the manufacturing process, though not as important as micron and length (Holt, 2006). Wool has fibres that can be spun into fine yarns, with great lengths of yarn for a given weight of wool and greater market value (Australian Wool Exchange, 2010).

Crimp is the natural waviness of Merino fibre and it varies with the diameter of the fibre. It is the degree of alignment of the crimp waves within a staple. ‘Crimp frequency’ is the number of crimp waves per centimetre of staple length (Rose and Pepper, 1999). Coefficient of variation of crimp frequency refers to the variation in frequency between staples within a lot (Holt, 2006).

2.8.3 Staple Length

A staple is a measure of the quality of the fibre with regard to its length or fineness. Numerous staples together form a fleece. A cluster of wool fibres is made by a cluster of follicles and the natural cluster of wool is held together due to individual fibres having the ability to attach to each other so that they stay together. When removed from the sheep the underside of the fleece shows all its distinct individual staples (Cottle, 1991).

The staple length of the wool is the length of the clip, and highly correlated with mean fibre length. Staple length generally determines the end use of wool, that is, whether it will be used in weaving or knitting. The longer wool, generally around 51 mm and longer, called combing types, are processed to worsted yarn (Smith *et al*., 1997). Age and age at shearing affect the length of wool. Staple length increases with the age of an animal until after maturity (Clair *et al*., 1948).

2.8.4 Tensile Strength

Staple strength is calculated as the force required to break per unit staple thickness, expressed as Newton's per kilotex (N/ktex) (Cottle, 1991). The staple strength of wool is one of the major determining factors when spinning yarn, as well as the sale price of greasy wool. Both staple length and staple strength influence the price paid for wool (Cape Wools S.A., 2011). The influence of staple strength on the price of fine wools rose from 13% in 1997/98 to 22% in 1998/99, while length accounted for 9% of the variation in prices paid in 1998/99 (The Wool mark Company, 1999). Wool is routinely measured for both length and strength in marketing and increasingly staple strength is being incorporated into breeding programs and performance recording of individual animals for selection.

Staple strength has been shown to be moderately to highly heritable in Merino sheep, although there is a wide range of published values, and so would be expected to respond to selection (Greeff *et al*., 1997). Staple length and staple strength are both heritable and should respond to selection. There is a negative relationship between staple strength and coefficient of variation of fibre diameter; small changes in coefficient of variation result in large changes in staple strength (Lewer and Li, 1994; Greeff *et al*., 1997).

2.8.5 Colour

Wool colour indicates whether it is possible to dye wool into lighter shades. Colour may be graded depending upon the natural colour, impurities and various stains present. Severely stained wool decreases prices dramatically. However, it is difficult to assess colour accurately without proper measurement, since some stains will wash out in the processing, whereas others are quite persistent (Smith *et al*., 1997).

2.8.6 Clean Yield

The unit of quantity "cy kg" is a kilogram (kg) of clean yield (cy). The term clean yield, except for purposes of carbonized fibres, means the absolute clean content. This means that the portion of the merchandise consisting of wool free of all vegetable and other foreign material would ordinarily be lost during commercial cleaning operation (United State of America Census Bureau, 2012).

2.8.7 Position of Break (POB)

Each staple is broken when measured. The proportion of staples which breaks in the tip, middle and base region are expressed as a percentage. POB is measured in conjunction with staple strength and is a measure of the position in the staple (base, mid or tip) where it will break given enough force (Australian Wool Innovation, 2012a). Both sections of the broken staple are weighed after the strength test, with the results converted into values indicating whether the staple was broken in the base, middle or tip region. The POB is useful in processing since it provides the processor with an indication of where fibres are likely to break, and thus the length of the broken fibre sections. If a staple breaks at the tip, then the broken fibres are either very short or probably lost as card waste or rather long. If the staple breaks in the middle, both fibre sections are of approximately equal length and both relatively short (Australian Wool Innovation, 2012b).

2.8.8 Comfort factor

When some wool fabrics are worn, a "tingling" sensation can be felt in the skin due to mechanical irritation from the coarser fibre ends on the skin surface. "Tingling" arises when a fabric has around 5 % or more fibres exceeding 30 microns. Therefore, wool comfort factor (CF) is a key indicator of wool quality (Malau-Aduli and Akuoch, 2012). The critical level of comfort for most wool-wearing consumers is when the maximum diameter of fibres in the yarn is around 30 microns. If more than five per cent of the fibres are greater than 30 microns, then consumers will find the garment uncomfortable to wear against the skin (Department of Agriculture, Fisheries and Forestry, 2005).

2.9 Summary

Sheep and wool production in the communal areas of Eastern Cape are characterised by poor growth performance, low fleece weight per sheep as well as low quality of wool. Given such challenges, it is therefore essential to investigate them further giving much attention to rangeland types, age and locality in order to bring about developmental programmes that will address such challenges and enhance sheep productivity. Most research on sheep has been undertaken in controlled conditions particularly at research stations. Results obtained in such studies are inapplicable to communal areas sheep production practices. Ecologically differences have an effect on rainfall pattern and precipitation which modulates livestock populations through the impact of seasonal droughts on rangeland productivity. Reliable and relevant information on productivity of sheep can be obtained through monitoring of changes in growth performances, wool quantity and quality in a period not less than a year or more.

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CHAPTER 3: Body conditions scores, body and fleece weights of woollen sheep in veld communal rangelands of the Eastern Cape

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Abstract

The objective of this study was to determine the growth performance and fleece weight of sheep in four smallholder farming communities of Eastern Cape Province, South Africa. Among the four communities studied, two (Roxeni and Tyabane) were in sweetveld and other two (Luzi I and Luzi II) were in a sourveld. Roxeni, Luzi I and Luzi II were also engaged in the ram exchange project with National Wool Growers Association (NWGA). Sixty crossbred ewes and 20 non-descript ewes of two to three years were randomly selected from the four communities studied and were measured during their annual shearing in October. They were assessed for average greasy fleece weight per head, body condition score and live weight after shearing. Sheep from Roxeni were heavier (39.9 ± 1.10kg) than sheep from Tyabane (29.8 ± 1.10kg) village. Sheep from Tyabane had the lightest ($P < 0.05$) fleece weight (1.0 ± 1.10kg) compared to those from Roxeni (3.1 ± 1.10kg) village. There was no significant difference ($P \geq 0.05$) in body condition scores of sheep from Roxeni and Luzi communities but they significantly differed ($P < 0.05$) from Tyabane sheep. The two-year old ewes had similar ($P \geq 0.05$) live weight to that of the three year old ewes. However, the three-year old ewes had higher (3.3 ± 0.11) ($P < 0.05$) body condition scores than the two-year old ewes (2.8±0.10). Two-year old ewes also had lower (1.9 ± 0.11kg) ($P < 0.05$) fleece weight than the three-year old ewes (2.3 ± 0.10kg). It was concluded that sheep that were raised in the sweetveld had higher live and fleece weights than the ones that were raised on the sourveld. The communities that were engaged on ram exchange project had sheep with higher live weights, body condition score and fleece weight.

KEYWORDS: Age, body condition score, live weight, communal rangelands, ewes, fleece weight

3.1 Introduction

Currently there are about 24 million sheep in South Africa with an estimated 3 to 4 million sheep in the former Transkei and Ciskei regions (Department of Agriculture, Forestry and Fisheries, 2010; King, 2013) and are grazed on extensive rangelands (Fayemi and Muchenje, 2013). Approximately 25% of sheep in South Africa are raised by communal farmers of the Eastern Cape and the Free State Provinces (Cape Wools, 2007; Mapiliyao, 2010). Sheep full fill a variety of benefits for communal farmers including economic products, by-products, risk mitigation, property security, investment, cultural uses and prestige (Mapiliyao *et al*., 2012). Growth performance of sheep is the key production indicator (Sibanda, 1999) and it has implications in the reproductive efficiency of sheep (Marchant, 2004). Fast growth performance allows sheep to breeds earlier and produces more lambs in their lifetime. Fast growth rate entails reaching market weight earlier and thus produces a quicker income to the farmer (Bela and Haile, 2009). The performance of sheep under communal management is not recorded although some evidence has been documented on sheep performance under traditional management (Abebe *et al*., 2000).

Sheep in the communal farming areas are not selected for growth performance traits, but are subjected to natural selection. On average, communal farmers in the Eastern Cape Province typically run flocks of 20 to 30 sheep. The communal sheep are of a small to medium frame size and resemble wool-type sheep, like the Merino (King, 2013). The ram exchange project, which commenced in August 2002, has shown a continuous improvement in the sheep's live weight and wool quality in the communal farming areas of Eastern Cape (King, 2005; De Beer, 2011). The ram exchange project supplies 3000 rams annually to communal farmers with the impact of the rams being evaluated in progeny tests. Sixteen ram breeding groups are being established in the communal areas that will eventually supply rams to the neighboring communities (Marais, 2005).

Communal grazing areas are managed under a communal land tenure system, where the rangeland resources are used by all members of the community. In communal production systems, farmers share the same grazing land, but each individual farmer manages their animals using their own experience (Western and Finch, 2004; Mapekula *et al*., 2010). In South Africa different pastures are described in terms of sweet, mixed and sourveld (Nqeno, 2008). Sweetveld remains palatable and wholesome even when mature, whereas sourveld provides palatable material only during the growing season (late spring and summer). Mixed veld is the intermediate between the two extremes (Hardy, 1999; Tainton, 1999). Information on the influence of different communal ecosystems on sheep production is scarce.

The growth performance of sheep and the quantity of wool produced per sheep in the communal farming areas of the Eastern Cape is low, resulting in low returns from both meat and wool production. This is reflected by the low average price per kilogram (r/kg) of wool produced by the communal farmers (National Wool Growers Association, 2011). Makapela (2008) stated that the average fleece weight of communal wool sheep in Eastern Cape ranges from 2-3kg compared to the range of 3-5kg per sheep in the commercial production. Wool is economically important in improving farmers' incomes (De Beer 2011), but this improvement has not occurred in the Eastern Cape; hence it becomes imperative to investigate this gap and evaluate the potential for livestock improvement strategies in this Province.

A study by Marais (2007) showed that, sheep grazing on communal rangelands have lower growth performance and fleece weight than sheep grazing on commercial rangelands. Mciteka (2005) also found that sheep that are kept on mountains perform better in growth and fleece weight than sheep that graze communally. However, Marais (2005) further stated that by introducing commercial rams to communal ewes of Eastern Cape, a significant improvement in growth is possible and that the ram breeding project of the NWGA could be of great commercial use in terms of wool quantity and quality and slaughter weight. Therefore, it is important to determine if the veld type, community and age have an effect on growth performance and fleece weight of sheep in the communal farming areas of Eastern Cape. The objective of the study was therefore to determine the body condition scores, body and fleece weights of woollen sheep in veld communal rangelands of the Eastern Cape Province.

3.2 Materials and Methods

3.2.1 Site description

The study was conducted in four different communal areas of the Eastern Cape Province of South Africa. The selected communities were Roxeni, Tyabane, Luzi I and Luzi II. Roxeni is a community in the Alice district and is situated at 32° 46` 0`` South, 26° 45` 0`` East with an elevation of 563m above sea level. Rainfall was 386 mm per year recorded at Fort Hare Research Farm (2001), mainly occurring during summer. The average daily temperatures range from a minimum of 19 °C in June to a maximum of 27.6 °C in February. The grazing area is constituted by grass and bush species in the plains and valleys. Grass species are dominant in valleys, while bush species dominate in mountainous areas.

Roxeni is a sweet veld type pasture (Acocks 1988) that remains palatable and nutritious throughout the year (Ellery *et al*., 1995; Botsime, 2006). The most dominant grass species include *Panicum maximum*, *Themeda triandra*, *Digitaria eriantha*, *Aristida congesta* and *Cynodon dactylon.* However, *Cynodon dactylon* is more dominant near homesteads where there is overgrazing. The most dominant 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 most dominant bush species is *Acacia karroo*, whilst the mountainous areas are dominated by *Olea africana* and *Ptaeroxylon oblique* (Acocks, 1988).

Luzi I and II are communities in the Mount Fletcher district, situated at 30° 46` 0`` South, 28° 29` 0`` East with an elevation of 1556m. The average rainfall per annum is 635mm with most rainfall occurring mainly during midsummer. The average daily temperatures range from a minimum of 16 °C in June to a maximum of 25.5 °C in January. These communities are both on sourveld areas. The dominant grass species are *Sporobolus africanas, Tristachya leuctthrix, Themeda triandra, Podocarpus latifolius, Canthium ciliatum, Leucosida sericea* and the dominant bush species are the *Aloe ferox, Crasula* species and *Acacia Mearnsii* (Tainton, 2000).

Tyabane is a community in Nqamakwe district, situated at 32° 4` 60`` N, 27° 49` 0`` E with an elevation of 744m. The average daily temperatures range from a minimum of 7 °C in July and to a maximum of 25.2 °C in February. The average rainfall per annum is 321mm, with most rainfall occurring mainly during midsummer, and it is situated on sweetveld (Tainton, 1999). The dominant grass species include *Digitaria eriantha, Cynodon dactylon, Aristida congesta* and *Themeda triandra.* The dominant bush species include *Acacia karroo, Olea Africana*, and *Ptaeroxylon oblique* (Acocks, 1988).

3.2.2 Study animals

A total of 80 ewes, randomly selected from different flocks of the communities and identified using ear tags, were used in this study. Twenty crossbred ewes (from non-descript ewes and purebred Merino rams) were selected in each community in Roxeni, Luzi I and Luzi II and twenty non-descript ewes were selected in different flocks of Tyabane village. Only two- and three-year-old ewes were used.

3.2.3 Sheep Management

The sheep at Roxeni, Luzi I and Tyabane were kraaled at night and grazed on rangelands during the day, from 0900hrs to 1730hrs with water available *ad libitum*. They were kept under extensive farming systems and natural flock mating was practiced whereby rams were running with ewes throughout the year. The animals were sheared once a year during the shearing season (October) in the shearing sheds. However, in Luzi II, sheep were kept and grazed on the mountains throughout the day and sheltered overnight in yards constructed as temporal shelters (*amagxamesi)*. They only came to the village during the shearing season in October. The shepherds also stayed on the mountains with the sheep and had their shelters pitched up there. Roxeni and the two Luzi communities participated in the NWGA breeding scheme and also had properly structured shearing sheds. In this scheme, home-grown rams were exchanged with purebred Merino rams annually during summer in order to promote autumn mating. Roxeni farmers bought veterinary medicines in bulk as a group and share according to the number of their sheep whilst in other communities; the farmers bought the veterinary medicines individually. Tyabane sheep, which were sheared in November, were not part of the NWGA breeding Scheme and in this community there was no shearing shed.

3.2.4 Data Collection

The sheep were monitored for their growth performance and fleece weight in each of the four communities during shearing season in October each year. The sheep were measured for post shearing live weight (LW), condition scores (BCS) and greasy fleece weight during the October shearing season in the four communities. Fleece weight was recorded immediately after shearing using a Libra Measuring Instrument (LMI) scale. BCS was scored immediately after shearing using a 1 to 5 scale, 1 being too emaciated, 2 thin, 3 average, 4 fat and 5 obese (Lifetime Wool, 2011). The ewes from Roxeni were further compared with ewes from Tyabane to determine the effect of the intervention of the ram project.

3.2.5 Statistical Analysis

The data was analysed using the Analysis of Variance (ANOVA) to determine effect of community, veld type and age on live weight (LW), body condition score (BCS) and fleece weight (FW). The General Linear Model of SAS (2003) was used to analyse the effect of community, age and veld type and their interactions on live weight, body condition score and fleece weight. Comparisons of the least square means were performed using the PDIFF procedure of SAS (2003). The following Generalized Linear Model was used:

$Y_{ijklm} = \mu + V_i + C_j + A_k + VA_l + E_{ijklm}$

Where:

Y_{ijklm} = Live weight, Fleece Weight or Body Condition Score;

μ = Constant mean common to all observations;

V_i = Effect of rangeland (sweetveld or Sourveld);

C_j = Effect of community (Roxeni, Tyabane, Luzi I or Luzi II);

A_k = Effect of age (2 years or 3 years);

VA_l = Interaction of rangeland and age;

E_{ijklm} = Random Error.

3.3 Results

3.3.1 Effects of community on sheep live weights, body condition scores and fleece weight

There was a significant difference (P <0.05) in live weight of sheep from the different communities. The live weights of sheep from Luzi I and Luzi II communities were not significantly different (P ≥0.05). Roxeni sheep had the highest live weight (39.9 ± 1.1kg), followed by the Luzi communities (35.9 ± 1.10kg), with sheep from Tyabane having the lowest (29.8 ± 1.10kg) live weight. There were significant differences (P <0.05) in body condition scores of sheep between Tyabane (2.2 ± 1.10) and the three other communities (Roxeni (3.1 ± 1.10) and Luzi (3.5 ± 1.10)). There were no significant differences in BCS (P ≥0.05) between sheep from Roxeni and Luzi communities. Both the Luzi communities had high BCS (3.5 ± 1.10), followed by Roxeni (3.1±1.10); Tyabane had the lowest (2.2 ± 1.10). There was a significant difference (P <0.05) in fleece weight between the communities. Roxeni sheep had the highest fleece weight (3.1 ± 1.10kg), followed by both Luzi communities (2.0 ± 1.1kg), and Tyabane had lowest (1.0 ± 1.10kg), as shown in Table 3.1.

Table 3.1 Least square means (± standard error of means) of sheep live weights, body condition scores and fleece weights as affected by community.

Community	LW(kg)	BCS	FW(kg)
Roxeni	39.9 ± 1.10^{c}	3.1 ± 1.10^{a}	3.1 ± 1.10^{c}
Luzi I	35.9 ± 1.10^{b}	3.5 ± 1.10^{a}	2.0 ± 1.10^{b}
Luzi II	35.9 ± 1.10^{b}	3.5 ± 1.10^{a}	2.0 ± 1.10^{b}
Tyabane	29.8 ± 1.10^{a}	2.2 ± 1.10^{b}	1.0 ± 1.10^{a}

$^{a, b, c}$ Values with different superscripts within a column are significantly different ($P < 0.05$)

LW = Live Weight

BCS = Body Condition Score

FW = Fleece Weight

3.3.2 Effect of age on average live weight, body condition score and fleece weight of sheep

There were no significant differences ($P \geq 0.05$) in the live weights of two and the three year old ewes in all the four communities. However, there were significant differences ($P < 0.05$) in BCS between the two and three year old ewes. Generally the three year old ewes had higher body condition scores (3.3 ± 0.11) than the two year old ewes (2.8 ± 0.10). Three year old ewes produced higher amounts of fleece (2.3 ± 0.11kg) than the two-year-old ewes (1.9 ± 0.11kg) and these were not significantly different ($P > 0.05$), as presented in Table 3.2. On calculating interactions, it was found that there were no interactions ($P \geq 0.05$) between age and sweetveld on live weight, body condition scores and fleece weight; however, age and sourveld had a significant ($P < 0.05$) effect on body condition scores and fleece weight. The three year old ewes had higher body condition scores (4.3 ± 0.35) than the two year old ewes (3.3 ± 0.35) and produced higher fleece weight (2.9 ± 0.33kg) than the two-year-old ewes (1.9 ± 0.33kg), also presented in Table 3.2.

Table 3.2 Least square means (± standard error of means) of sheep live weights, body condition scores and fleece weights based on age

Age (years)	LW (kg)	BCS	FW (kg)
Overall results			
2	35.0±0.80[a]	2.8±0.10[a]	1.9±0.10[a]
3	35.8±0.81[a]	3.3±0.11[b]	2.3±0.10[b]
Sweetveld			
2	39.9±3.32[a]	2.8±0.41[a]	3.1±0.35[a]
3	45.3±3.32[a]	3.3±0.41[a]	3.0±0.35[a]
Sourveld			
2	35.8±2.28[a]	3.3±0.35[a]	1.9±0.33[a]
3	39.6±2.28[a]	4.3±0.35[b]	2.9±0.33[b]

[a,b] Values with different superscripts within a column are significantly different ($P < 0.05$)

LW = Live Weight

BCS = Body Condition Score

FW = Fleece Weight

3.3.3 Effect of veld type on sheep live weight, body condition scores and fleece weight.

The live weight of ewes in the sweetveld (39.6 ± 1.21kg) was significantly higher (P <0.05) than that of ewes in the sourveld (36.0 ± 1.21kg). The body condition scores of ewes raised in sourveld was also significantly different (P <0.05) from those of ewes raised on sweetveld, with sourveld-raised ewes having higher body condition scores (3.5 ± 0.20) than those raised on the sweetveld (3.0 ± 0.20). The fleece weight of ewes raised on sweetveld (2.9 ± 0.11kg) was higher (P <0.05) than the fleece weight of sourveld-raised ewes (2.1 ± 0.11kg), as presented in Table 3.3.

Table 3.3: Least square means (± standard error of means) of Live Weight, Body Condition Score and fleece weight of sheep in the communal veld types Eastern Cape

Veld type	LW (kg)	BCS	FW (kg)
Sweetveld	39.6±1.21[b]	3.0±0.20[a]	2.9±0.11[b]
Sourveld	36.0±1.21[a]	3.5±0.20[b]	2.1±0.11[a]

[a,b] Values with different superscripts within a column are significantly different ($P < 0.05$)

LW = Live Weight

BCS = Body Condition Score

FW = Fleece Weight

3.4 Discussion

The observation that sheep from Roxeni were heavier than other communities could be ascribed to feed availability and farmer resources ownership. This area is a sweetveld and in this veld type grasses remain palatable and retain a relatively high nutritive level throughout the winter (Hardy, 1999). The sheep were fewer in this community, which translates into more feed per sheep as sweetveld is characterized by lower rainfall (<600mm per annum) than sourveld areas (>600mm per annum) (Palmer, 2003; Palmer and Ainslie, 2006; Mapekula, 2009). It is easy to experience drought on lower rainfall areas, which results in fodder shortages. Therefore, lower stocking rates must be applied in this veld type (Hardy, 1999). The heavy weights could be attributed to a combination of sweetveld condition, lower stocking rate, as well as management, where improved breeds of Merino rams were used to upgrade the local stock.

Unlike in Roxeni, Tyabane, which is also on a sweetveld, had the lowest sheep live weight. This observation could be ascribed to the rams which were used for mating with non-descript breeds and were inferior, with poor growth and wool quality (Marais, 2007). Tyabane village did not participate in the ram project for flock improvement. The farmers in this community used their home-grown rams, which does not bring new genetics to the flock and the long lifespan of rams in the flock without replacement might result in inbreeding. Inbreeding can cause negative effects on productive traits of sheep (van Wyk *et al*., 2009; Selvaggi *et al*., 2010); hence, sheep productivity could be low in Tyabane.

Upgrading the non-descript communal breeds with pure bred Merino rams contributes significantly towards the improvement of sheep performance, which eventually improves the quality and quantity of wool produced (Olivier, 2007; De Beer, 2012). This programme commenced in 2002 and has shown a huge upgrading of communal sheep performance, wool quality and quantity, as well as the alleviation of starvation of farmers (King, 2005; De Beer 2011).

The observation that ewes from Luzi I and Luzi II had high body condition scores could be ascribed to high precipitation at the end of the cool-dry season every year, which results in abundant feed in summer (Ellery *et al*., 1995). The high rainfall guarantees the presence of feed in the hot-dry season. This is in agreement with findings reported by Mapiliyao (2010) whereby, during the hot-wet season, body condition scores were almost the same across the two villages of sweetveld and sourveld. The similar performance of sheep from Luzi I and Luzi II is in contrast with findings reported by Mciteka (2005) who stated that sheep that were kept in the mountains during the day and night were in a better condition than those kept in kraals at night. This could be ascribed to the same vegetation type that was found in these two areas, although high temperatures during hot season might drop the performance of sheep kept in mountains.

The observation that Tyabane had the lowest body condition score might be due to drought and high sheep numbers in this village. This village has experienced a spring drought almost every year for the past three years and it had high stocking density as the grazing land was not adequate to accommodate the sheep that were grazing on it.

Sheep from Roxeni had the highest fleece weight compared to the other three communities and this is in agreement with Tainton (1999) who indicated that sweetveld areas have highly nutritive feed throughout the year due to the average rainfall received. This community receives 386mm per year and was dominated by palatable grass species such as *Panicum maximum, Themeda triandra, Digitaria eriantha, Aristida congesta* and *Cynodon dactylon* (De Bruyn, 1999). Fleece weight is influenced by feed on offer (Lifetime Wool, 2011). Therefore, availability of feed on sweetveld throughout the year resulted in high amount of fleece produced by sheep from Roxeni. Moreover, the mentorship from the NWGA and the Eastern Cape Department of Rural Development and

Agrarian Reform (DRDAR) officers also played an important role in management practices of sheep. The NWGA production advisors in collaboration with DRDAR extension officers advised the farmers on sheep management, breeding, shearing, wool sorting and baling as well as its marketing (Eastern Cape Department of Agriculture, 2008; De Beer, 2011).

The live weight, body condition scores and fleece weight differences between the two- and three-year-old ewes could be attributed to environmental adaptation of the ewes. 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 (Lifetime Wool, 2011). The age effect of sheep on their live weight and fleece weight could be ascribed to the uniform availability of high nutritive feed in these areas throughout the year. Properly fed lambs have higher daily weight gain, because they use feed more efficiently at this stage of growth (Hamito, 2010). Therefore, supplementing these young growing sheep with feed and water during overnight kraaling could have positive effect on growth rate and wool production (Mapekula, 2013). The effect of the age of sheep kept in sourveld on live weight, body condition scores and the fleece weight could be attributed to the uniform growth of ewes and management (Bela and Haile, 2009).

The difference observed on BCS of sheep kept under sourveld conditions was associated with the high quality vegetation during the hot wet seasons. The sourveld provides good spring grazing, but is far less satisfactory than sweetveld in the autumn (King, 2013). Lyle (1991) reported that the crude protein content of sourveld is at its highest in spring and declines during late summer with a drastic decline in quality after the autumn frost. It reaches a low point in nutritional value before the onset of spring growth. Therefore, the sheep were in good condition in May, but their condition declined in spite of having access to sufficient high protein feed from the veld in the previous months (Lyle, 1991; Nowak, and Poindron, 2006) The sheep raised in the sweetveld had heavier live weight and fleece weight than those raised in the sourveld; this could be as a result of the high nutritive value of feed in the sweetveld. The sourveld soils are poor with low pH and as a result grasses have poor nutritive value leading to unpalatability (Tainton 2000). Yet, in the sourveld, the sheep body condition scores were higher than the ones in the sweetveld. This could be attributed to an abundance of feed available in summer due to high precipitation. Sourveld areas receive a rainfall of 600mm and more per annum, which upholds excess herbage growth during the hot-wet season (Ellery *et al*., 1995; Simela *et al*., 2006; Mapekula, 2009).

Sheep from Roxeni were observed to have the highest live weight, body condition scores and fleece weight than sheep from Tyabane, although both the communities were in sweetveld area. This could be attributed to the fact that ram exchange project, management, and mentorship received in Roxeni. This study agrees with the study by Marais (2007) which showed the body and fleece weights of progeny born of commercial rams were significantly higher than those of the progeny of communal rams. The Tyabane community did not participate in the ram project and had previously experienced long spring drought. However, Roxeni has participated in the ram project since 2002 (King, 2005) and had highly productive sheep. Therefore, further studies are needed to identify the wool quality in these communities.

3.5 Conclusions

The study revealed that sheep reared on a sweetveld had higher live weights and fleece weights than sheep reared on the sourveld. However, sheep on sourveld had higher body condition scores than those raised on sweetveld. It was also found that sheep from communities where commercial rams were used to up-grade non-descript communal breeds had higher live weights, body condition scores and fleeces weight than the ewes bred with home grown rams.

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CHAPTER 4: Quality attributes of sheep wool raised in the sweet and sourveld communal rangelands of Eastern Cape Province, South Africa.

Abstract

The objective of this study was to evaluate the wool quality attributes on four communal rangelands of Eastern Cape Province. The study area and study animals used are fully described in chapter 3. Wool samples were collected from each ewe during shearing. The wool samples were tested and measured for fibre diameter, crimps, clean yield, position of break, strength, and length and comfort factor. Wool from Roxeni, Luzi I and Luzi II had lowest fibre diameter ($P < 0.05$). Wool from Roxeni had highest clean yield ($P < 0.05$) followed by wool from Luzi I and Luzi II and wool from Tyabane had lowest clean yield percentage. Wool from sheep grazing on sweetveld had higher ($P < 0.05$) clean yield percentage (74.3 ± 0.71%) than those grazed on sourveld (71.7 ± 0.71%). The staple mid breaks were higher (69.5 ± 5.25) and base breaks were lower (7.5 ± 5.25) in sweetveld ($P < 0.05$) than in sourveld (30.5 ± 5.25) and (92.5 ± 5.25) respectively. There were no interactions between age and veld type ($P \geq 0.05$) on wool quality traits. It was concluded that young ewes had high quality wool than the older ewes raised on communal rangelands.

KEYWORDS: age, communal areas, ewes, sourveld, sweetveld, veld type, wool characteristics

4.1 Introduction

In Chapter 3, it was observed that the veld type and community affected the live weights and fleece weights of the sheep. It was also observed that age did not have an effect on growth performance of the sheep. The wool quality, which includes fibre diameter, clean yield, crimps, length, strength and position of break, is dependent on growth performance of sheep. It is a versatile product, which is in-demand mainly because of its physical characteristics that directly influence wearer comfort (Hatcher *et al*., 2010; Swan, 2010; Holman and Malau-Aduli, 2012), processing performance, durability and textile attributes (Holman and Malau-Aduli, 2012). Wool is not a uniform biological product since its physical characteristics vary depending on sheep genetics, environment and management strategies (Warn *et al*., 2006; Holman and Malau-Aduli, 2012). Significant wool characteristics consist of fibre diameter, coefficient of variation, comfort factor, fibre curvature or crimps, spinning fineness, staple length and clean fleece yield (Denney, 1990). The influence of these characteristics on wool quality and value differs; yet, they contribute to an entire fleece (Cottle, 2010; Holman and Malau-Aduli, 2012).

Although in South Africa apparel wool is produced throughout the country, it is mainly produced in the drier regions. On a Provincial basis, the Eastern Cape is the largest wool-producing region, producing 25.1% of the national clip, followed by the Free State (24.1%), Western Cape (19.9%), Northern Cape (12.5%) and Mpumalanga with 7.7% (Department of Agriculture, Forestry and Fisheries, 2011). The South African wool industry provides a high quality, environmentally-sound product which meets the needs of the textile industry. 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. The South African wool has, over the years, earned a reputation for uniformity, softness to the touch and other quality features (De Beer, 2011).

The quality of wool produced by communal farmers is poor. The main reasons for poor wool production are the poor communal sheep, inbreeding practices and the unavailability of good quality feed during winter months (Makapela, 2008). However, the income from wool has become the main source of income for the communal farmers in the Eastern Cape Province. Due to ram project intervention, wool production and income showed a huge increase over the past ten years (De Beer, 2011). In the wool season of 1997/98, the rural wool farmers produced 222 610 kilograms of wool at an income of R1 502 908. In the season of 2010/11, the wool farmers produced 2 890 062 kilograms of wool and received an income of R69 124 707. A concern is that approximately 1.8 million kg of wool is sold to traders outside the formal market at a much lower price (De Beer, 2011; King, 2013). The wool of these communal animals lacks the characteristics of Merino wool. Staple length is generally shorter than that of commercial sheep. Kemp fibres are often found in the fleeces. The wool of the sheep lacks the creamy white colour, resulting in slightly off-colour wool and sometimes black or brown coloured sheep are found. Most of the sheep are shorn in sheds that are run by the NWGA, which acts as a producers' organization for wool sheep farmers (De Beer, 2012).

The quantity of wool produced in the communal farming areas of the Eastern Cape is poor, resulting in low returns. This is shown by a low price of wool produced by the communal farmers (National Wool Growers Association, 2011). In these communal areas, fleece weight per sheep is between 2kg and 3kg. This is below the wool production of the commercial farmers who produce between 4kg to 5kg per sheep at an average growing period of 12 months (Makapela, 2008). Wool has a great income potential to wool producing farmers, and it can improve the farmers' income (De Beer 2011); therefore, it is important to evaluate the wool quality traits in the communal areas.

The Eastern Cape consists of different veld types that are favourable for sheep production and is the best producer of wool in South Africa (National Wool Growers Association, 2011). In a study by Marais (2005), the intervention of introducing commercial rams to communal flocks shows a significant improvement in communal wool quality and slaughter weight of sheep. Thus, it is important to evaluate the quality of wool of sheep at different ages in different veld types and in communities that participate on ram exchange and those that do not participate. The main objective of this study was therefore to evaluate wool quality attributes on sheep that were crossed with purebred Merino rams and those that were not crossed under sweet and sourveld communal rangelands of the Eastern Cape Province.

4.2 Materials and Methods

4.2.1 Site description

The study site was described in 3.2.1

4.2.2 Study animals

The study animals were described in 3.2.2

4.2.3 Sheep Management

The sheep management was described in 3.2.3

4.2.4 Sheep shearing and data collection

Sheep were sheared once a year in October by two different teams of shearers using the blade method (sheep scissor). A wool sample of 25 to 35g per sheep fleece was collected after shearing in each community. The collected wool samples were sent for measurements to the Wool Testing Bureau (WTB) in Port Elizabeth. The wool samples were analysed for fibre diameter, comfort factor, clean yield, tensile strength, staple length, crimps, and position of break (top, base or mid).

Roxeni and the two Luzi communities participated in the NWGA breeding scheme. In this scheme, home-grown rams were exchanged with purebred Merino rams annually during summer in order to promote autumn mating. Tyabane sheep, which were sheared in November, were not part of the NWGA breeding Scheme.

4.2.5 Statistical analysis

The Generalized Linear Model of SAS (2003) was used to analyse the effect of community, ewe age, veld type and their interactions on quality attributes of wool. Comparisons of the least square means were performed using the PDIFF procedure (SAS, 2003). The following Generalized Linear Model was used:

$Y_{ijklm} = \mu + V_i + C_j + A_k + VA_l + E_{ijklm}$

Where:

Y_{ijklm} = Wool quality attributes (fibre diameter, comfort factor, clean yield, tensile strength, staple length, crimps, and position of break (top, base or mid));

μ = Constant mean common to all observations;

V_i = Effect of rangeland (sweetveld or Sourveld);

C_j = Effect of community (Roxeni, Tyabane, Luzi I or Luzi II);

A_k = Effect of age (2 years or 3 years);

VA_l = Interaction of rangeland and age;

E_{ijklm} = Random Error.

4.3 Results

4.3.1 Effect of community on quality of wool

There were no significant differences (*P* ≥0.05) in fibre diameter between Roxeni, Luzi I and Luzi II sheep. However, there were significant differences (*P* <0.05) in fibre diameter between Tyabane and the other three communities. Roxeni sheep had lowest fibre diameter (20.7 ± 0.41µm), followed by Luzi II (21.1 ± 0.41µm) and Luzi I (21.2 ± 0.41µm); Tyabane wool had highest fibre diameter with 22.3 ± 0.41µm. There were no significant differences (*P* ≥0.05) in comfort factor between the four communities. Clean yield (cy) percentage of wool from Roxeni (73.8 ± 1.45%) was significantly different (*P* <0.05) from the three other communities. Clean yield of Tyabane wool (63.1 ± 1.45%) was also significantly different (*P* <0.05) from the other communities. However, wool from Luzi I and Luzi II (68.2 ± 1.42% and 68.1 ± 1.42%, respectively) did not show any significant differences (*P* ≥0.05), as shown in Table 4.1. There were no significant differences (*P* ≥0.05) in wool crimp amongst all the communities. There were no significant differences (*P* ≥0.05) between the four communities on wool length.

Wool strength between Roxeni (35 ± 2.21N/ktex) and both Luzi communities' wool was not significant different (*P* ≥0.05) but differed significantly (*P* <0.05) from Tyabane (13 ± 2.21N/ktex). There were no significant differences in staple position of break (POB) between Roxeni and Tyabane (*P* ≥0.05); however, the POB significantly differed (*P* <0.05) in both the Luzi communities. Luzi II had lower mid-breaks (19.7 ± 8.11mm) and higher base-breaks (78 ± 8.11mm) than other communities (*P* <0.05), also presented in Table 4.1.

Table 4.1 Least square means (± standard error of means) of sheep wool traits among the communities

	Roxeni	Luzi I	Luzi II	Tyabane
Fibre diameter (µm)	20.7 ± 0.41[a]	21.2 ± 0.41[a]	21.1 ± 0.41[a]	22.3 ± 0.41[b]
Comfort factor (%)	95.2 ± 1.22[a]	94 ± 1.22[a]	95.5 ± 1.22[a]	92.3 ± 1.22[a]
Clean yield (%)	73.8 ± 1.45[c]	68.2 ± 1.45[a]	68.1 ± 1.45[a]	63.1 ± 1.45[b]
Crimps	13.1 ± 1.82[a]	12.4 ± 1.82[a]	10.4 ± 1.82[a]	11.8 ± 1.82[a]
Staple length (mm)	74.9 ± 2.44[a]	72.6 ± 2.44[a]	69.1 ± 2.44[a]	66.7 ± 2.44[a]
Staple strength (N/ktex)	35 ± 2.21[b]	36.9 ± 2.21[b]	31.8 ± 2.21[b]	13 ± 2.21[a]
Tip (mm)	3 ± 1.83[a]	11 ± 1.83[b]	3.6 ± 1.83[a]	1.1 ± 1.83[a]
Mid (mm)	62.8 ± 1.83[b]	54.8 ± 1.83[b]	19.7 ± 1.83[a]	72.8 ± 8.11[c]
Base (mm)	34.2 ± 1.83[a]	34.2 ± 1.83[a]	78 ± 1.83[b]	26.1 ± 8.11[a]

[a,b,c] Values with different superscripts within a row are significantly different ($P < 0.05$)

4.3.2 Effect of veld type on the quality of wool

Veld types (sweetveld and sourveld) did not have any significant effect ($P \geq 0.05$) on fibre diameter, comfort factor, clean yield, staple strength, length and tip. However, veld type had significant effects ($P < 0.05$) on wool crimp, base- and mid-breaks. Sheep raised in the sweetveld had higher ($P < 0.05$) clean yield (74.3 ± 0.71), wool crimp (13 ± 0.71) and mid-breaks (69.5 ± 5.25mm) than sheep raised in the sourveld: 71.7 ± 0.71, 8.8 ± 0.71 and 7.5 ± 5.25, respectively, as presented in Table 4.2.

Table 4.2 Least square means (± standard error of means) of sheep wool traits based on veld type

Quality attributes	Sweetveld	Sourveld
Fibre diameter (µm)	20.7 ± 0.91[a]	21.4 ± 0.91[a]
Comfort factor (%)	95.8 ± 3.28[a]	94.1 ± 3.28[a]
Clean yield (%)	74.3 ± 0.71[b]	71.7 ± 0.71[a]
Crimps	13 ± 0.71[b]	8.8 ± 0.71[a]
Staple strength (N/ktex)	35.5 ± 4.75[a]	29 ± 4.75[a]
Staple length (MM)	71.8 ± 3.33[a]	70.5 ± 3.33[a]
Tip (mm)	0 ± 0.0[a]	0 ± 0.0[a]
Mid (mm)	69.5 ± 5.25[b]	7.5 ± 5.25[a]
Base (mm)	30.5 ± 5.25[a]	92.5 ± 5.25[b]

[a,b] Values with different superscripts within a row are significantly different ($P < 0.05$)

4.3.3 Interaction between age and veld type on quality of wool

There were no differences (*P* ≥0.05) in strength, length, position of break of wool between the three year old ewes and the two year old ewes on sweetveld. The two year old ewes had lower (*P* fibre diameter (20.3 ± 1.31µm), clean yield (73.9 ± 0.54) and mid breaks (69 ± 9.55) than the three year old ewes in sweetveld, 21.2 ± 1.31µm, 74.6 ± 0.54 and 70 ± 9.55, respectively. However, the three year old ewes had lower (*P* ≥0.05) comfort factor (94.8 ± 5.82), wool crimp (12 ± 0.75), staple strength (3.5 ± 10.43), length (68 ± 5.87) and base-breaks (30 ± 9.55) than the two-year-old ewes on sweetveld, 96.9 ± 3.02, 14 ± 0.75, 3.6 ± 10.43, 75 ± 58 and 31 ± 9.55, respectively, as demonstrated in Figure 4.1. There was no effect (*P* ≥0.05) of age of ewes and the sourveld on fibre diameter, comfort factor, clean yield, wool crimp, staple strength, staple length and position of break of wool.

However, the two year old ewes had lower (*P* ≥0.05) fibre diameter (20 ± 1.57µm), staple length (68 ± 3.66mm), and base breaks (85 ± 3.52mm) than three year old ewes, 22 ± 1.57µm, 73 ± 3.66mm and 100 ± 58mm, respectively. Furthermore, the three year old ewes had lower comfort factor (89.9 ± 5.82%), clean yield (70.2 ± 0.67%), wool crimp (8.5 ± 1.32), staple strength (26 ± 3.55N/ktex) and mid breaks (0 ± 3.52mm) than the two year-old ewes, whose parameters were higher: 98.3 ± 5.82%, 73.3 ± 0.67%, 9.0 ± 1.32, 32.0 ± 3.55N/ktex and 15 ± 3.52, respectively, also presented in Figure 4.1.

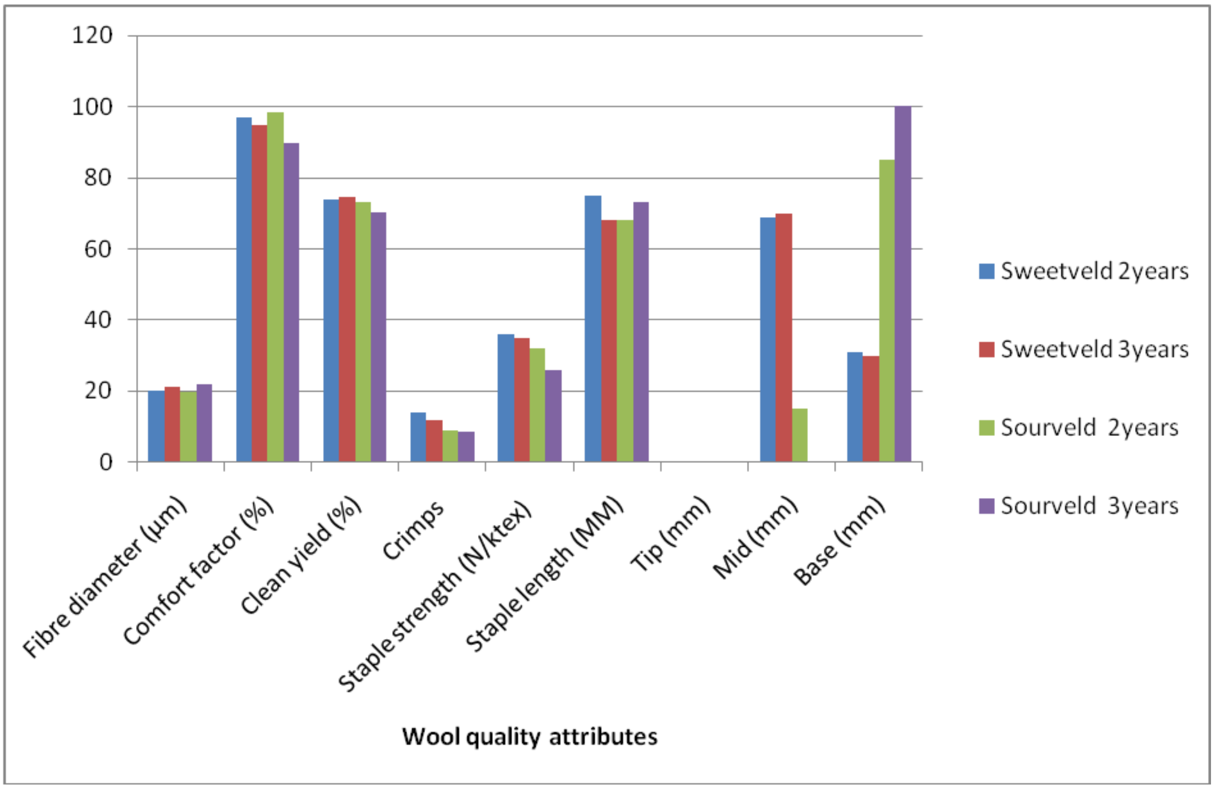

Figure 4.1 Interaction between age of sheep and veld type.

4.4 Discussion

Effect of community on wool characteristics

The observation that Roxeni and the Mount Fletcher communities (Luzi I and Luzi II) had finer wool than Tyabane was associated with the breed type. These three communities upgraded their non-descript sheep breed through use of pure breed Merino rams. Marais (2005) reported that the communal ewes mated with commercial rams had offspring with finer wool than the offspring from communal rams and ewes. Comfort factor was similar ($P \geq 0.05$) for all communities; this is attributed to the lower mean fibre diameter and wool crimps within the communities (Malau-Aduli and Akuoch, 2012).

The observation that Roxeni had the highest clean yield percentage was associated with sophisticated management, such as avoidance of wool contamination. This is also in agreement with a study by Marias (2005) who discovered that offspring from commercial rams had high clean yield percentage. Although sheep in Luzi I were kraaled at night and those in Luzi II were kept on mountains, these sheep groups had similar clean yield percentage and that was attributed to similar vegetation in these communities (Tainton, 1999). This is in contrast with a study by Mciteka (2005) who discovered that sheep in Transkei, which are kept in the mountains during day and night, had higher wool production than those that are kept in kraals during the night.

The staple length had no significant differences ($P \geq 0.05$) within and amongst the communities. The observation that Roxeni, Luzi I and Luzi II had strong staple strength could be associated with breed type. These three communities have been upgrading their non-descript sheep with purebred Merino rams since 2002 (King, 2007). Moreover, diversity in veld type in these communities brought differences in the availability of feed (Acocks, 1988).

Effect of veld type on wool quality

The observation that crimps were more numerous in sheep that grazed on sweetveld than those which grazed in sourveld was attributed to the availability of palatable feed. This resulted in finer wool than in the sourveld, which consists of palatable grass only when it is young and loses palatability as it matures (Acocks, 1988; Frank *et al*., 2006). The observation that the Position of Break (POB) had high mid-breaks in Roxeni, Luzi I and Tyabane could be associated with time of shearing and sudden changes in the nutrition during winter rainfall areas. Nutrition and time of shearing are the best ways to reduce the percentage of mid-breaks in wool.

Farmers should manage sheep nutrition throughout the year to maintain an even profile along the length of the fibre. The key is to maintain the supply of nutrients to the follicles during these stress times, particularly when midway between shearing dates (Australian Wool Innovation, 2012). If the break is within 10mm of either end of the staple, the Length and Strength test is less likely to break the staple at this point, increasing the overall strength measure.

Interaction of age and veld type on wool characteristics

In the sweetveld, the age of ewes had no influence ($P \geq 0.05$) on wool characteristics. However, wool from two year old ewes in the sweetveld had a lower fibre diameter than the three-year-old ewes. This is in agreement with Frank *et al*. (2006) who reported that as the fleece-bearing animals grow older, their skin surface area increases. This results in a decline in follicle densities and an associated increase in mean fibre diameter. This shows that younger ewes have finer wool than older ewes.

The data also showed that the two-year-old ewes in sweetveld had higher comfort factor than the three year old ewes. This could be ascribed to the fact that as the mean fibre diameter increases because of aging or the growing of the animal (Frank *et al*., 2006), the fibre comfort factor decreases and results in discomfort to the wearer (Malau-Aduli and Akuoch, 2012).

The two year old ewes had lower clean yield than the three year old ewes. This is in agreement with the results of Snyman (2012), where in an interaction between age of ewe and production traits, the clean yield percentage of the fleece increased with an increase in age. The two year old ewes had higher number of crimps than the three year old ewes. This could be caused by the fact that) various quality characteristics of wool tend to deteriorate with age and crimp abnormalities may appear (Muhammad *et al*., 2012). Younger ewes produce wool with low fibre diameter and it increases with age resulting in a decreased comfort factor and crimp. Finer wool consists of many crimp wavelengths and decrease as fibre gets courser.

The staple strength was higher in two-year-old ewes (36 ± 10.4N/ktex) than the three-year-old ewes (35 ± 10.4N/ktex). However, both the two year old and the three year old ewes had sound wool which withstands the processing. This is in agreement with results of Bartona *et al*. (1994) which showed that in wool produced during the three wool-selling seasons between 1989/90 and 1991/92, the poorer staple strength was reflected by a high proportion of tender or partially-tender wool in the wool from weaners and hoggets than in mature sheep. The mature ewes of 1.5 to 3 years produced sound wool of 35.5 to 36.8N/ktex. This could be ascribed to sufficient nutrients from grazing (Acocks, 1988; Muhammad *et al*., 2012).

It was also observed that the two year old ewes had longer wool than the three year old ewes. This is in agreement with Staikova and Stancheva (2009) where in an evaluation on the effect of some factors on wool yield and staple length at different ages in sheep, the value of staple length at 1.5 year of age was higher by 37.58% than the value at 2.5 years of age. This also agrees with a study by Clair *et al.* (1948) which revealed that age at shearing affects the length of wool. This could be ascribed to high nutritive feed in the sweetveld (Greeff, 2006; Lianne, 2007), and due to the fact that the young ewes have high feed conversion efficiency (Malik *et al*., 1996), they convert the feed into wool more than the older ewes.

It was observed in position of break (POB) that there were more mid-breaks in both the two year old and three year old ewes than base-breaks. This could be ascribed to sudden changes in nutrition, such as the winter breaks in winter rainfall areas (sourveld), which can cause breaks in the wool fibre (Australian Wool Innovation, 2012). Supplementary feeding during and prior to these periods may help to offset the effect of these seasonal breaks.

There were no interactions between the ages (two and three year old) and the veld types (sweetveld and sourveld) (P >0.05) on characteristics of wool. However, there were insignificant differences amongst the characteristics. Wool from two year old ewes had lower fibre diameter than three-year old-ewes. A similar study by Frank *et al*. (2006) revealed that as the mean fibre diameter increases due to aging of the animal, the fibre comfort factor decreased from 98.3 ± 5.82% in two year old ewes to 89.9 ± 5.82% in three-year-old ewes. This results in discomfort of the fibre when it is worn (Department of Agriculture, Fisheries and Forestry, 2005).

The two year old ewes were observed to have a higher clean yield (73.3 ± 0.6%) than the three year old ewes (70.2 ± 0.6%). This is in contrast with Snyman (2012) who stated that the clean yield percentage of fleece increased with age. This could be ascribed to dust, vegetable matter and other contaminants that the older (three year old) ewes had been exposed to more than the younger (two year old) ewes.

Wool crimps from two-year-old ewes were insignificantly different (9 ± 1.3) from three year old ewes (8.5 ± 1.3). The wool crimp decreased with an increase in fibre diameter (Muhammad *et al*., 2012). The two year old ewes had stronger (32 ± 3.58N/ktex) wool than the three year old ewes (26 ± 3.58N/ktex). In the sweetveld, the two-year-old ewes had shorter wool (68 ± 3.5cm) than three year old ewes' wool (73 ± 3.5cm). This is in contrast with Staikova and Stancheva (2009) who reported that younger ewes had longer staples than older ewes. This could be ascribed to better adaptation by the older ewes than the young ones.

Roxeni ewes had lower fibre diameter than Tyabane although these communities were both on sweetveld. This could be ascribed to different breeding management in these two communities. The farmers of Roxeni had been upgrading non-descript sheep with the purebred Merino for more than ten years. This results in softer, stronger and longer wool (Olivier, 2005; National Wool Growers Association, 2011). The staple strength was observed to be stronger in Roxeni ewes than in Tyabane ewes. This is associated with changes in plane of nutrition (Australian Wool Innovation, 2012) and use of quality wool ram breed (Olivier, 2005). The insignificant difference in other characteristics was associated to the same vegetation, rainfall and veld type in these communities (Tainton, 1999).

4.5 Conclusions and recommendations

The ewes that were raised on the sweetveld had high wool quality than the ewes raised on sourveld. It was also found that ewes that were upgraded with commercial Merino rams had higher wool quality than the ewes that were mated with home-grown rams. It is highly recommended to use purebred quality Merino rams so that the quality of wool, as well as its value, can be improved. It is also recommended that farmers manage the nutrition of the sheep throughout the year so that there can be an even profile along the length of the fibre. This would also assist in break points by supplying nutrients to follicles during these stressful times, particularly when they occur midway between shearing dates. Supplementary feeding during winter periods (and just prior to shearing) may aid in offsetting the effect of the seasonal staple breaks.

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CHAPTER 5: General Discussion, Conclusion and Recommendations

5.1 General Discussion

Sheep play multiple production roles and are essential to the resource poor farmers (Saico and Abul, 2007; Mapiliyao, 2010). For viable implementation of sustainable sheep production interventions, it is necessary to evaluate their growth performance, the quality and quantity of wool produced by each ewe (Mahanjana and Cronje, 2006). The information generated will assist in the understanding of growth and wool performance of the wool sheep to communal farmers (Medina and Ramirez, 2005), rather than identifying constraints to sheep productivity in isolation.

The study was intended to evaluate the growth performance and wool production characteristics of crossbred Merino ewes and non-descript sheep in four communal areas of Eastern Cape Province. All the ewes were grazing on rangelands and were under the communal grazing systems and management. No supplementary feeding was provided to these sheep. The performance characteristics measured were sheep live weights, body condition scoring, fleece weight and wool quality attributes in the sweet- and sourveld communal rangelands of Eastern Cape. This study was addressed through two trials.

The growth performance and fleece weight of woolled sheep in sweetveld and sourveld communal rangelands of Eastern Cape were assessed in Chapter 3. In this first trial (Chapter 3), sheep were monitored for live weight, body condition scoring and fleece weight. The hypothesis tested was that communal areas have no potential to produce wool sheep with high growth performance and fleece weight in their rangelands. Ewes from Roxeni had higher live weight and fleece weight than ewes from both the Luzi communities, while Tyabane had the lowest sheep live weight, condition scores and fleece weight.

There were no interactions between the age of ewes and sweetveld, whereas sourveld and the age of ewes had some interactions. The breed also had an effect on performance of sheep. The ewes bred from Merino rams had higher performance than the ones bred from non-descript rams. The crossbred ewes raised on sweetveld had higher performance than the ones that were raised on a sourveld. Although the management type was similar, variation could have been caused by the differences in agro-ecological factors, like veld type, variation in precipitation, causing fluctuation in forage quality and quantity.

In Chapter 4 the main aim was to determine the quality of wool produced in the two different agro-ecological rangelands in four communities. In this trial, fibre diameter, comfort factor, clean yield, wool crimp, staple length, staple strength and position of break of communal sheep wool were determined and compared. The hypothesis tested was that the communal areas have no potential to produce sheep with high wool quality in the communal rangelands. Wool samples were collected from a total of 80 ewes of two to three years old. Twenty ewes were randomly selected from each community. Ewes from Roxeni had the highest quality wool followed by Luzi II; Tyabane had lowest quality wool. The type of breed also had an effect on wool quality. The ewes bred from pure bred Merino rams with non-descript ewes had finer wool than the non-descript ewes. The quality of wool decreased with age and veld type. As the ewe grew older, the wool gets courser and less strong.

5.1 Conclusions

The ewes that were raised on the sweetveld had higher live weights, fleece weights and wool quality than the ewes raised on the sourveld. The three-year-old ewes had higher live weights and fleece weights than the two year old ewes. However, the two year old ewes had higher wool quality than the three year old ewes. It was also determined that the ewes that were upgraded with commercial Merino rams had higher growth performance, fleece weights and wool quality in both the sweetveld and sourveld than the ewes that were bred from home-grown rams in sweetveld.

5.2 Recommendations

It is recommended to use the sweetveld areas for sheep and wool production and also that participation in ram projects would further increase the performance of sheep and quality of wool, as well as its value. Therefore communal farmers both in sweet veld and sourveld areas should participate in the ram exchange project run by NWGA as it has shown an increase in production. Production advisors, along with extension officers, should reach all the communities that have the potential for wool production for advisory services. Nutrition and proper management is also recommended so that there is an even profile along the length of the fibre. This would also help in break points by supplying nutrients to the follicles during stress times, particularly when they occur midway between shearing dates. Supplementary feeding during these periods (and just prior to shearing) may help to offset the effect of these seasonal breaks. In addition to the issues raised above, more research should be conducted focusing on the following:

- Veld condition assessment in each grazing should be incorporated to determine sheep performances in different rangelands
- Sheep should be assessed on their grazing areas
- Adaptation of the NWGA rams in different communal farming areas of Eastern Cape

5.3 References

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Appendix 1 Body Condition Scoring Form

SHEEP NUMBER	Condition
1 = too emaciated Ribs, lumbar vertebrae, pelvic bones and all body prominences evident fro[m] distance. No discernible body fat. Obvious absence of muscle mass.	
2 = Thin Ribs easily palpated and may be visible with no palpable fat. Tops of lumbar vertebrae visible. Pelvic bones less prominent. Obvious waist and abdominal tuck	
3 = Average Ribs palpable without excess fat covering. Abdomen tucked up when viewed from side.	
4 = Stout General fleshy appearance. Ribs palpable with difficulty. Noticeable fat deposits over lumbar spine and tail base. Abdominal tuck may be absent.	
5 = Obese Large fat deposits over chest, spine and tail base. Waist and abdominal tuck absent. Fat deposits on neck and limbs. Abdomen distended.	

Appendix 2 Live weight and Fleece Weight Form

Sheep number (ear tag)	**Number of teeth**	**Live weight** (kg)	**Fleece weight** (kg)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Appendix 3 Wool Sample collection form

Sheep number (ear tag)	**Sample number**	**Sample weight** (kg)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		