SHEEP PRODUCTION PRACTICES, FLOCK DYNAMICS, BODY CONDITION AND WEIGHT VARIATION IN TWO ECOLOGICALLY DIFFERENT RESOURCE-POOR COMMUNAL FARMING SYSTEMS

by

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Declaration

I, **Luke Mapiliyao**, vow that this dissertation has not been submitted to any University and that it is my original work conducted under the supervision of Prof. V. Muchenje. All assistance towards the production of this work and all the references contained herein have been duly accredited.

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Approved as to style and content by:

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Abstract

Sheep production practices, flock dynamics, body condition and weight variation in two ecologically different resource-poor communal farming systems

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The objective of this study was to determine sheep production practices, constraints, flock dynamics, body condition and weight variation in two ecologically different resource-poor communal farming systems of the Eastern Cape Province of South Africa. Mean sheep flock sizes per household were not significantly different between the two ecologically different areas (villages); Gaga (19.0±3.10) and Sompondo (18.3±3.10). Shortage of feed, disease and parasite were reported the most important constraints across the two villages. In both villages, sheep housing was poorly constructed using acacia brushwoods. Fewer farmers owned rams: the rams to ewes ratio for the two villages were 1:20, 1:19 for Gaga and Sompondo, respectively. The low ram: ewe ratios reported suggest that inbreeding might have been reducing productivity of their flocks. There was also uncontrolled breeding due to undefined and mating seasons. Gall sickness, heart water and footrot caused most of the sheep mortalities. Dohne Merinos were the common genotypes in the two villages. Total entrances for each flock were higher ($p < 0.05$) in hot-dry season and hot-wet season than in other seasons. Most of the entrances were lambs and were born in hot-dry season (September) and cool-dry season (June) for larger flocks (10.90 ± 3.02) and for small flocks (3.65 ± 3.02). High lamb mortalities were experienced in the post-rainy (April) and hot-wet (December) season. There was a significant interaction between season and flock size. Most of the sales occurred in the hot-wet season. Ecological area had significant effect on sheep production

potential ($p < 0.05$) in both flock classes. The average sheep production efficiency (SPE) value for Gaga and Sompondo were 0.50 ± 0.116 and 0.50 ± 0.096 respectively. The SPE for large flock was higher ($p < 0.05$) by season and flock size. Large flocks had a higher ($p < 0.05$) SPE values and the SPE ranged from 1.11 ± 0.193 in April, a post-rainy season month to 1.55 ± 0.193 in December, a hot-wet season month. Lamb mortalities constituted the greater part of outflows. High lamb mortalities occurred in hot-wet (December), hot-dry (September) and post-rainy (April) seasons. There was a significant interaction between season and age of sheep on body weight of sheep. Highest ($p < 0.05$) body weights were recorded in the post-rainy and autumn season in both lambs and ewes. It is therefore very important to come up with affordable interventions which take into play ecological differences of the areas for improved nutritional status of sheep in communal areas which will lead to improved sheep productivity and the poor-resourced farmer human nutritional and livelihood.

Key words: Exits, entrances, sheep production potential, sheep production efficiency, body condition score, body weight, mortalities, diseases

List of abbreviations

BCS – Body Condition Score

BW – Body weight

CLA - Causing caseous lymphadenitis

FAO - Food and Agriculture Organisation

GLM - Generalised linear model

NGOs - Non Governmental Organisations

PROC CORR-Procedure of correlation

PROC NPARIWAY-Procedure of non-parametric 1 way

PROC - Procedure

SAS - Statistical Analysis System

SME - Starvation, mismothering exposure

SPE - Sheep production efficiency

SPP - Sheep production potential

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CHAPTER 1: Introduction

1.1 Introduction

Sheep play an important role in the South African livestock industry (Brundyn *et al.*, 2005). They are widely distributed across the different agro-ecological zones of South Africa, where they contribute to the livelihoods of the human population as source of food security and poverty alleviation (Gatenby, 1986; Newton, 1995; Miao *et al.*, 2005). The main economic sheep products are cash, meat, milk, leather, wool and other by-products such as dung for fuel or fertilizer (Haenlein and Ramirez, 2007). Sheep are also an important symbol of wealth (Shackleton, 1995; Bayer *et al.*, 2001), but the relative importance of each function varies with production system, rangeland type and farmers' socio-cultural factors as is the case with other animal species (Chimonyo *et al.*, 1999; Botsime, 2006; Simela *et al.*, 2006).

The flocks allow families the opportunity to experience the reward of raising sheep while providing additional income to the family. Sheep can utilise rangelands that other domestic animals cannot, their ability to survive on limited amounts of coarse feed comes as an opportunity for smallholder farmers to realise more income from raising sheep (Newton, 1995; Kosgey, 2004; Haenlein and Ramirez, 2007). Sheep are reserved for special guests or at ceremonial gatherings such as marriage feasts weddings, funerals, chief installations, field days and circumcision ceremonies. They are also given as sacrificial offerings to appease avenging spirit and ancestors (Kosgey, 2004).

There is limited reliable information of performance levels, constraints and opportunities of sheep in most communal areas. This makes it difficult to design and implement communal area based developmental programmes that benefit the communal farmers. It, therefore, is

imperative to understand the current status; constraints faced by farmers in the communal areas who are into sheep production. Development of sheep enterprise can be a sustainable way of improving food security and livelihoods of the resource-limited farmers (Miao, 2005). Regardless that sheep are highly prolific animals, they face major constraints such as shortage of feed, poor health and poor housing management leading to high lamb mortalities (Homman *et al.,* 2007). Some of these constraints can also lead to poor quality meat which can impact negatively on sheep industry (Akhilu, 2002; Muchenje *et al.,* 2008). Also constraints such as lack of technical expertise, prevalence of predators and rustlers severely affect sheep production in communal areas.

Indices such as production potential and production efficiency have been developed (Muchadeyi *et al.,* 2005; Chiduwa *et al.,* 2008*).* Production potential is the proportion of mature and growing sheep to the total flock/herd size and is important in computation of production efficiency. Production efficiency is a variable that reflects the proportion of potentially saleable animals sold and /or slaughtered by farmers. Production potential and production efficiency have been implemented in the description of communal chicken (Muchadeyi *et al.,* 2005), pigs (Chiduwa *et al.,* 2008) and goats (Rumosa Gwaze *et al*., 2009) and cattle (Mapiye *et al*., 2009). However, evidence of similar studies on sheep is scanty. Determination of efficiency of sheep production systems is crucial in generating intervention strategies to improve sheep productivity. It is of necessity to monitor sheep flock dynamics and identify the major constraints to sheep production, with the full and active farmer participation.

1.2 Justification

The livestock dynamics research by Rumosa Gwaze *et al.* (2008) and Mapiye *et al.* (2009) ignored sheep. These authors also ignored the aspect of quality (weight and body condition score) and influence of agro-ecological regions, yet these have got influence in the dynamics of the animal species. Adoption and improvement of sheep productivity gives resource-poor farmers the opportunities to earn better cash and improve on the general living standards. For the policy makers to come up with sustainable sheep developmental programmes, it is important to understand the communal farm characteristics and their farming systems. Strategies to improve sheep productivity will be done with full participation of farmers hence it is assumed that it will be easily adopted.

On-farm performance of sheep and its contribution to the livelihood of the resource-poor communal farmer is not very clear. It is therefore of paramount importance to conduct in-depth research on flock sizes, their structures, and how they vary with their body conditions and weights, with season as an attempt to quantify the contribution of sheep to the livelihoods of communal smallholder farmers. In the communal areas, sheep productivity is very low and this is due to various constraints and the major ones are; diseases and parasites, feed shortage, poor housing, lack of marketing skills and infrastructure and lack of information. For the government to embark on the programmes that are targeted at improving sheep productivity there is a need to know the constraints faced by the communal farmers. The information generated by this research will assist in the formulation of policies as well as institutional reforms to easy constraints and assist in the transformation of resource-poor communal farmers to prosperity.

1.3 Objectives

The broad objective of this study was to determine sheep production practices, constraints, flock dynamics, body condition and weight variation in two ecologically different resource-poor communal farming systems.

The specific objectives were to determine:

1. The production practices and constraints to sheep productivity in ecologically different communal areas.
2. Flock dynamics, BCS and body weight of sheep in two ecologically different communal areas.

1.4 Null hypotheses:

1. There is no difference in sheep production practices and constraints in the two ecologically different villages.
2. There is no difference in the flock dynamics, BCS and body weight of sheep in the two ecologically different areas.

1.5 Reference

Akhilu, Y., 2002. An Audit of the livestock marketing status in Kenya, Ethiopia and Sudan, Volume 1, Nairobi, Kenya: Community Based Animal Health and Participatory Epidemiology unit, Pan African Programme for the control of Epizootics and the Organisation of the African Union / Inter Africa Bureau for Animal Resources.

Bayer, W., von Lossau, A., Feldmann, A., 2001. Smallholders and community-based management of farm animal genetic resources. Proceedings of the workshop held in Mbabane, Swaziland, 7-11 May 2001. Food and Agriculture Organisation of the United Nations Rome, 2003.

Botsime, B.D., 2006. Influence of Agro-Ecological Region on Selected Anthropometrical Measurements of Nguni in South Africa, PhD Thesis, University of Pretoria, South Africa

Chiduwa, G., Chimonyo, M., Haliman, T.E., Chisambara, S.R., Dzama, K., 2008. Herd dynamics and contribution of indigenous pigs to the livelihoods of rural farmer in a semi – arid area of Zimbabwe. *Tropical Animal Health and Production* **40** (2), 125-136.

Chimonyo, M., Kusina, N.T., Hamudikuwanda, H.A., Nyoni, O., 1999. A Survey on land use and usage of cattle for draught in a semi-arid environment. *Journal of Applied Science of Southern Africa* **5** (2), 111-122.

Gatenby, R.M., 1986. Sheep Production in the Tropics and Sub Tropics, Longman Inc., New York (1986), 3331 pp. Grandin, B.E., de Leeuw, P.N., de Souza, M., 1991. Labour and Livestock Management. In: Bekure, S., et al. (Ed), An Analysis of the Livestock System of Maasai Pastoralists in Eastern Kajiado District, Kenya. ILCA

(International Livestock Centre for Africa), Systems Study. ILCA, Addis Ababa, Ethiopia.

Haenlein, G. F. W., Ramirez, R. G., 2007. Potential mineral deficiency on arid rangelands for small ruminants with special reference to Mexico. *Small Ruminants Research* **68,** 35-41.

Homman, S., van Rooyen, A., Moyo, T., Nengomasha, Z., 2007. Goat Production and Marketing: Baseline Information for Semi Arid Zimbabwe, Bulawayo, Zimbabwe: International Crops Research Institute for the semi arid tropics. http.//www.cipav.org.co/irrd/irrd17/10/map17115.htm.acessed:04/11/2005.

Kosgey, I.S., 2004. Breeding objectives and breeding strategies for small ruminants in the Tropics. Ph.D. Thesis. Wageningen University, The Netherlands, 272 pp.

Mapiye, C., Chimonyo, M., Dzama, K., 2009. Seasonal dynamics, production potential and efficiency of cattle in the sweet and sour communal rangelands in South Africa. *Journal of Arid Environments* **73**, 529-536.

Miao, Z. H., Glatz, P. C. and Y. J. Ru., 2005. Free-range poultry production--A review. *Asian-Austlian Journal of Animal Science* **18**(1), 113-132.

Muchadeyi, F.C., Sibanda, S., Kusina, N.T., Kusina, J., Makuza, S.M., 2005. Village Chicken Flock Dynamics and Contribution of Chickens to Household Livelihoods In A Small Farming Area In Zimbabwe. *Tropical Animal Health And Production* **37,** 333 – 334.

Muchenje, V., Dzama K., Chimonyo, M., Strydom, P. E., Hugo A ., Raats, J.G., 2008. Some of the biochemical aspects pertaining to beef eating quality and consumer health: A review. *Food Chemistry* **112,** 279 – 289.

Newton, T. H., 1995. Sheep Production Research: The Development of Small Ruminants in the Developing Countries. Small Ruminants in African Agriculture, pp 128-141.

Rumosa Gwaze, F., Chimonyo, M., Dzama, K., 2009. Communal goat production in Southern Africa. *Tropical Animal Health Production* (2009) **41,** 1157-1168.

Shackleton, C.M., 1995. The Direct Use Value of Goods and Services Attributed to cattle and Goats in the Sand River Catchments, Bushbuckridge, CSIR- Environment Report No ENV-P-C 99003, CSIR, Pretoria.

Simela, L., Montshwe, B.D., Mahanjana, A.M., Tshuwa, M.P., 2006. The Livestock Production environment in the South African small holder sector. New challenges for the animal science industries. SASAS 41st Congress Abstracts, pp 66.

CHAPTER 2: Literature Review

2.1 Introduction

Although livestock production is the most important agricultural activity in most of the countries in Southern Africa, it is often practised under unstable and detrimental climatic conditions (Chikagwa-Malunga and Banda, 2006) which are further exacerbated by harsh encroachment or desertification. The breeding strategies followed in Southern Africa generally depend on the environment and the level of management. Producers vary from sophisticated commercial to communal subsistence producers (Braker *et al.,* 2002). Despite the considerable availability of published research on indigenous small ruminants in Southern Africa, much of the work was conducted under controlled conditions at research stations (Braker *et al.,* 2002). Consequently, results are often not applicable to communal production systems in rural areas which are characterised with shared animal production resources such as grazing and water resources.

According to United Nations Food and Agriculture Organisation (FAO, 2005), the world largest sheep population was estimated at 1059.8 billion flocks with South Africa contributing about 25.3 million. Besides contributing such significant important attributes, sheep in the communal areas are not getting enough recognition. In the communal farming areas of Southern Africa, sheep graze in natural pastures or utilize crop residues and their by products whose supply and quality fluctuates seasonally. Differences in agro-ecological zones exist and this has an effect on precipitation which has got an effect on vegetation with lowland rangeland having sweet perennial grasses which are nutritious and palatable throughout the year and highland rangeland having annual grasses which lose nutritive value and palatability during the dry season (Ellery *et al*., 1995).The impact of these differences in rangeland type on sheep in communal areas has an impact on sheep population dynamics.

Due to high utilization of land by human and livestock, the land is degraded (Sundquist, 2003). Poor land use policy coupled with adverse effects of soil erosion and overgrazing, results in low productivity of sheep in Southern Africa (Desta *et al.,* 2000). Several infections, especially in young animals are influenced by unavailability or inadequate feed. Therefore this review discusses importance of sheep, performance measure of sheep production in communal areas and constraints faced by sheep – growers in communal areas. Furthermore it discusses the factors that infringe on sheep general welfare and methods that can be used to determine health and nutritional status of sheep.

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

2.2 Smallholder sheep production and their characteristics

Smallholder farming systems are generally associated with lack of adequate production resources. The most limiting constraint faced by the smallholder sheep farmers on sheep production in Southern Africa in general, and South Africa in particular, is the shortage of grazing land (Mahanjana and Cronje, 2006). Such scenario leads to food insecurity and leads to poverty in the poor resource communal farmers. Shortage of capital, diversified

agriculture and informal labour arrangements derived from family members (de Sherbinin *et al.,* 2008), with some non agricultural activities to supplement household incomes characterises the smallholder farming systems of South Africa. Lack of managerial skills as well as general socio economic characteristics, these constitutes low production in sheep. However, promotion of use of indigenous breeds that are adaptable to the semi- arid conditions could be one option of empowering the small holder sheep farmers.

2.2.1 South Africa indigenous sheep breeds, distribution and their characteristics

Indigenous breeds survive in harsh environment and under poor nutritional conditions. This characteristic makes the indigenous sheep breeds suitable for the communal areas where extreme conditions are the norm rather than the exception. Table 2.1 summarises characteristics of indigenous sheep breeds found in South Africa.

Table 2. 1: Main characteristics of indigenous sheep breeds and their distribution

Breed	Location	Breed characteristics	Phenotypic characteristics
Pedi	North West	Very hardy and adapts to extreme temperatures and arid conditions. Dual purpose as both its wool and meat are useful. Natural tolerance of diseases found in their environment e. g. ticks.	Brown head and white body. Some are patterned brown and white the whole body. It has long legs.
Blinkhaar Ronderib Afrikaner	Northern Cape	Have long strong legs for long distance walks. Extremely hard mutton/ wool breed. Heels close together like desert animals.	Soft, fine, shiny hair and some have coarse hair. Generally with white body and no wool.
Nguni	Kwazulu Natal	Can survive without water and adapts easily to desert conditions. Adapt to different and sometimes challenging conditions. Survive and flourish where other sheep breeds die.	It has a black, brown, or reddish brown coat.
Damara	Northern Cape	Highly productive and low maintenance. Very fertile and highly. Ewes are very protective and are able to defend their lambs against small predators and larger raptors. They are very hardy and tough.	Black and white or white and brown patterns in their body colour.
***Dohne Merino**	South western Cape Free state Eastern Cape	Good lamb growth ability.Hornless sheep with a good meat conformation and high quality fine to medium Merino wool.	Hornless with fine to medium Merino wool.

Source : ARC, 2006; *DAGRIS, 2008.

2.2.2 Importance of sheep to a communal farmer

In less developed countries, such as South Africa, direct economic returns from sheep products are very important, but household use by the owner, family or tribe is equally important. Sheep are regarded as a sign of wealth or prestige by indigenous South Africans. There are some economic roles played by sheep, and that includes the provision of milk, meat, manure, cash, skin (Haenlein and Ramirez, 2007). Meat and milk are for family consumption and sold to meet emergency needs like cash for school fees (Kosgey, 2004). It can also be used for barter trading (Morand – Fehr *et al*., 2004). Wool from sheep is used to make expensive jackets and the skins are used to make mats, footwear, tents and drums (Peacock, 2005). Sheep are also kept for sport or religious and ritual reasons (Kosgey, 2004). As in other Sub Sahara African countries (Benson *et al.,* 2001) sheep are kept as an investment. These reasons can lead to changes in flock structure, which have to be considered in improvement plans.

2.2.3 Performance measure of sheep production under communal conditions

The productivity of livestock in communal areas can be estimated using production efficiency index (Muchadeyi *et al*., 2005; Chiduwa *et al*., 2008). Production potential refers to the proportion of mature and growing animals to the total flock/herd size and is crucial in the computation of production efficiency. The production efficiency reflects the proportion of potentially saleable animals sold and/or slaughtered by farmers. The index is more informative (Mapiye *et al*., 2009) compared to off-take since it measures both the extent to which the resource-poor farmer produces saleable animals and the proportion of saleable sheep that they dispose through sales and/or consumption (Muchadeyi *et al*., 2005; Chiduwa *et al.*, 2008). The efficiency takes factors of production on board and this can assist in identifying constraints to livestock production. Very little, if any, information on the

production potential and efficiencies in communal sheep production systems of South Africa exist. It is therefore, of paramount importance to determine the efficiency of sheep production in the communal areas and constraints faced by communal farmers.

2.3 Constraints to sheep production in communal areas

Productivity of sheep in communal areas is generally low due to constraints of which the major ones are diseases and parasites (Ben Salem and Smith, 2008), lamb mortality, poor marketing management (Kusina and Kusina, 1999), limited feed availability, shortage of extension delivery staff and lack of farming records.

2.3.1 Disease and parasites

Prevalence of diseases and parasites is very high in the region of Southern Africa (Githiori *et al.,* 2006). Its impact is experienced through high mortalities, abortions or sub-clinical effects manifested as loss of weight in animal. The diseases and parasites can impact negatively through financial implications involved in controlling the effects of disease and mortality (Mahusoon *et al*., 2004; Sissay *et al.,* 2006). Lambs because of their age, they are more susceptible to diseases and parasites. Diseases can also cause still births (Aitken, 2007).

High incidences of diseases and mortality are attributed to the poor hygiene and precariousus housing conditions. Prevalence of diseases such as diarrhoea is high at the beginning of the rainy season, especially to lambs. Under communal set up, livestock are usually reared extensively (Bayer *et al.,* 2001), this promotes parasitism, increases infection and makes it difficult to put in place measures to control. Internal parasites reduce feed

intake, feed efficiency utilisation and increase the endogenenous loss of protein in the gastro intestinal tract (Alexandre and Mandonnet, 2005).

Very little support has been put on the ground by the government to control and research on diseases and parasites in sheep in communal areas. Veterinary and small ruminant improvement programmes are very minimal (Alexandre and Mandonnet, 2005). High cost of veterinary services and its unavailability (de Vires, 2008), worsens the situation. For health management strategies adoption, it is of necessity to identify causes of mortality and to investigate prevalence of diseases by type and by dynamics (Chiejina *et al.*, 2002), so as to reduce mortality of lambs. Smallholder farmers respond differently in times of disease occurrences, they do nothing because of lack of financial resources to purchase veterinary medicine they end up using ethno veterinary or medicine, modern (conventional) medicine originally intended for humans (Mapiye and Sibanda, 2005). In this scenario farmers are advised to practise minimum hygiene standards to reduce build up of infective agents and contaminated water as they are contributory factors to high lamb mortality (Peacock, 1996).

2.3.2 Poor marketing management

In most developing countries, little national investments on marketing inputs and services, research and advocacy has been done (Lebbi, 2004). Formal marketing of sheep in communal areas is characterised by absent or ill – functioning markets (Kusina and Kusina, 1999; Seleka, 2001; Moll *et al*., 2007). Smallholder households are often located in the marginal areas characterised with poor communication infrastructure particularly access roads to markets, thereby limiting sheep farmers' capacity to transport sheep to the few available slaughter facilities (Bayer *et al.,* 2001). These constrain the farmers thereby forcing them to opt to sell their sheep through informal markets whereby they compromise

on prices. The purchasers usually use a visual assessment of the animal instead of weight. In most countries intermediaries purchase live animals for resale in other areas, such as cities, towns and schools (Kusina and Kusina, 1999; Lovelace *et al.*, 2000; Simela et al., 2006).

Smallholder sheep farmers can increase their revenue base by adding value to sheep products, by conducting market research promoting sheep products, by convincing the public on health benefits associated with consumption of sheep meat (Peacock *et al*., 2005) through offering promotions and advertisements. For farmers to economise on transport for ferrying sheep to auction floors there is a need to form cooperatives and pull their resources together (Kusina and Kusina, 1999), so that they spread the cost and realise meaningful income returns. Risk that smallholder producers face are linked with prices, quality, quantity and timing of delivery. Transaction costs (Hobbs, 1996), is another factor which has significant impact on marketing decision. Some factors like age, education and farm profit, (Hobbs, 1997), affect farmers in their marketing channel choice.

2.3.3 Limited Forage Availability and Feed scarcity

In appropriate grazing (Quinn *et al.*, 2007), rangeland fires and seasonal droughts limit the availability of fodder (Ben Salem and Smith, 2008) in the communal areas. Poor management of rangelands (Papachristou *et al.*, 2005), causes deterioration in quality and quantity of forage. The quality and availability of natural pastures is highly variable in the tropics with crude protein dropping below 8% in dry mature tropical grasses, especially during the dry season (Bakshi and Wadhwa, 2007; Raghuvansi *et al.*, 2007; Ben Salem and Smith, 2008). Forage is of high quality in the wet season, but because of high temperatures, rapid physiological maturation follows, leading to early lignifications and reduce digestibility of grasses. In the sweet rangelands, which is characterised by natural browse

with a crude protein content of approximately 20%, there is not much variation in terms of protein content of feed with season (Peacock *et al.*, 2005). In the sour rangeland, this is characterised mainly of grassveld of good quality in the hot – wet season and becomes unpalatable in the cold – dry season (Botsime, 2006).

For survival and sustenance of sheep production during dry season, feeds should be preserved during the period of glut (Ben Salem and Smith, 2008). During the time of scarcity animals are graded and the ones with higher nutritive requirements are supplemented for example sheep in lamb. These may utilize conserved materials like silage, hay, crop residues and food processing by products (Garcia – Torres *et al.*, 2003). Any *Acacia karroo* available in some areas can form a natural browse and be supplementary ingredients for sheep. Any form of dietary supplementation intensifies management but increases productivity of sheep. The economic benefits of any supplementation programme may have to be considered.

Sheep in Southern Africa primarily graze on natural pastures or utilise, whose supply and quality fluctuate seasonally. The land is degraded due to high and increasing human and livestock population, worsened by poor land use policy resulting in low productivity of the system (Sundquist, 2003). Overgrazing, soil and organic matter burning and soil erosion are all major concerns (Desta *et al.*, 2000). Inadequate access to feed influences the severity of several infections, particularly in young animals (MacRea *et al.*, 1993). Integrated combined efforts of improving land tenure policies to promote natural resource management, livestock productivity through reducing stressors (e.g. diseases) by herd/flock health management, genetic means (e.g. within and between breed selection, crossbreeding), and improving productivity per unit of input is of paramount importance.

2.3.4 Extension delivery services

Information diffusion takes place only in part through formal extension services (Homman *et al.,* 2007). Social networks also play an important role especially for women, who often have less access to formal channel of dissemination yet because men's and women's networks often differ, extension should be disseminated through a range of networks. These linkages and resulting networks of exchange seem to be one of the reasons why they are able to survive under some of the harshest physical conditions (Kusina and Kusina, 1999). Experience suggests that linkages between farmers exist both in the absence and in the presence of official extension services, warranting further consideration of the significance and contribution of these networks to agricultural development. Extension worker to farmer ratio has widened and extension services become less accessible, especially to the resource poor farmers (Ferrington, 1994). Farmer led extension which promotes farmers and other rural people as agents of change in their communities, has been one popular innovation in local advocacy (Ferrington, 1994).

The emphasis is on the need for development agents, including agricultural extension and research, to participate in meaningful ways with smallholder farmers in order to ensure natural resource management, sustainable production and agricultural growth (Scoones and Thompson, 1994; Reij and Waters-Bayer, 2001; Perret and Mercoiret, 2003; Pound *et al.*, 2003). The reasoning behind this argument is that farmers have many of the solutions to their own problems (Reij and Waters-Bayer, 2001), or can at least make meaningful contributions to solving their problems by virtue of knowledge regarding their circumstances and local environment (Chambers *et al.*, 1989; Scoones and Thompson, 1994). The combination of farmers' knowledge and that of appropriately focused research and extension can be a formidable force in agricultural development as the two can

complement one another (Scoones and Thompson, 1994; Reij and Waters-Bayer, 2001; Perret and Mercoiret, 2003; CIA, 2005). This illustrates that much of the success of smallholder farmers relies on their local networks with one another and their self-initiated innovations to improve and adapt their practices in light of changing circumstances within the contexts in which they function; often marginal and risk prone environments (Scoones and Thompson, 1994; Reij and Waters-Bayer, 2001). Some successful projects have been carried out in sub-Saharan Africa, the success of which involved farmer innovations and linkages amongst farmers and between farmers and agricultural development agencies (including NGOs and official extension and research services). However, in many cases appropriate external support was lacking (Reij and Waters-Bayer, 2001) and farmers used whatever resources they could to compensate. Examples emphasising local innovations include the Indigenous Soil and Water Conservation and the Promoting Farmer Innovation projects in sub-Saharan Africa which encouraged groups of farmers to share and further develop their innovations by collaborating with development supporting agencies, usually in the form of NGOs (Reij and Waters-Bayer, 2001).

2.3.5 Unavailability of records

A functioning record-keeping system that reflects the community's breeding goal is of fundamental importance in sheep flock dynamics. In Malawi (Mwale *et al.,* 1999; Mulume *et al.,* 1999), farm projects have demonstrated that farmers are willing to collaborate in a record keeping scheme if no counter productive interventions take place and information and knowledge is made available to livestock farmers. Poor resource communal farmers should keep information to help on production trends analysis. Farmers on the ground are not very much active on records keeping. Record keeping should be done specifically on age, weight and diseases that affect the flock. Furthermore communal farmers should keep a

separate record of female sheep, the information to be kept along comprises of its age at first lambing, lambing intervals and a comparison whether it produces triplets, twins or singles. The capturing of information necessitates ranking of the flock into classes which is a vital tool in culling. Communal farmers should also capture information regarding costs incurred on drugs, vaccines, supplementary feeds and income received from sale of sheep and their products.

2.4 Sheep welfare communal areas

There is a strong incentive to keep sheep health and well. Sheep sustain the community (Assad *et al.,* 1997), and without them, life is difficult, especially in rural communities where there may be no alternative employment other than keeping livestock. In developing countries concern for animal welfare is based on self-interest rather than moral responsibility. For example, in communities where sheep are valued with pride because of the social status that goes with ownership, it might be undignified to mistreat the animal (Webb Ware *et al*., 2000) rather than immoral. The welfare problems vary with production system, and a good starting point is to identify the problems associated with animal welfare.

2.4.1 Effects of weather calamities in lamb rearing

Young lambs are particularly susceptible to death from hypothermia. Cold, wet weather (Chikagwa-Malunga and Banda, 2006) increases the chance of a lamb dying from starvation. Conditions at ten degrees Celsius within thirty minutes of birth have been noted, to cause death. The change to more fecund breeds is increasing the lamb mortality from hypothermia, and multi gravity ewe and its foetus are also at risk during the period of underfeeding if the ewes are on poor condition at the start of pregnancy and they receive inadequate feed the foetus will be lighter and this raises the risk of lamb mortality at birth if

the weather turns bad (Mc Neil *et al.,* 1999). The risk of pregnancy toxaemia in the ewe is also high.

2.4.2 Heat Stress and Lamb Mortality

Most of the sheep which are found in Semi Arid Regions of Africa, seasonal stress is caused by heat. Under hot, sunny conditions ewes make good use of shade, partly to get out of the glare and partly to stay cool. In the absence of shade the ewes form tight groups and tend to hold their heads in the shade provided by the bodies of other sheep. The heat load from the sun can approach the magnitude of the animals' metabolic heat production, and shade is a particularly important form of protection. Drinking more water is not an efficient way of cooling the body (Abdel-Moneim *et al*., 2009) but provide prompt short term relief. Panting reaches a maximum when rectal temperature is at 40.5°C and at 42°C lambs are near their survival limit (Lowe *et al.,* 2002). Severe heat stress in the last stage of pregnancy inhibits the growth of placenta and foetus independently of reductions in feed intake. This can also result in mortalities and abortions.

Death due to dystocia is more common in large single lambs than in twins, whereas deaths from starvation, mismothering exposure (SME) are common in low birth weight lambs (Hall *et al*., 1995). Dystocia presents risk of fatigue in the ewe and loss of interest in the lamb, as well as liver rapture in the lamb during delivery. Mismothering and lamb rejection are seen most commonly when lamb stocking density in the lambing paddock is too high.

2.4.2 Weaning

Early weaning is an inevitable stress for lambs but when performed at 16 weeks of age the stress is not severe and it is not sufficient to cause immune suppression (Rhind *et al.,* 1998).

Bonding between lamb and ewes, is strong up about 100 days following lambing, and even when there is limited suckling beyond that age; they maintain contact up to at least 190 days. It is the initial separation from the ewe that is stressful for the lamb. Familiarity with being briefly separated eliminates the plasma cortisol response to subsequent permanent separation (Sowinska *et al.,* 2001). The elevations in cortisol are greater if the separation is total compared with situations where the ewe and the lamb can still see each other. In parts of Africa, where it is not possible to keep sheep in separate groups, weaning is sometimes achieved by coating or plugging the teats with dung to reduce their appeal, or tying them with a cord.

2.4.3 Trauma

Common causes of trauma include injuries from shearing equipment, barbed wire, handling in yards, predation, dog worrying, road accidents and falls. Leg injuries can occur in lambs housed indoors on shatted floors that are not well maintained. Most shearing cuts are partial – thickness rather than full – thickness cuts. Breeds with ribby pelts are more prone to shearing scars (Holst *et al.,* 1997). Severing teats, valvas, pizzle sheaths and raised abscesses is a risk in all breeds and some shearers place their fingers over these parts to reduce the risk of cutting into the sheep. Shearing cuts close to leg tendons can cause permanent walking disorders, and deep cuts in the neck have been known to result in excessive bleeding and death. Shearing cuts can also pose a risk of infestation with fly strike larvae and infection with the bacteria causing caseous lymphadenitis (CLA) (Hall *et al*., 1995). Suffering associated with predation takes two forms. There is suffering associated with chase and being mauled, and there is protracted fear associated with the repeated threat of production. Flocks that are regularly predated become apprehensive and flightily at the

least provocation. This can make them more difficult to manage during routine procedures (Hutson, 2000).

Predation occurs after the lambs and ewes have been turned out to rangeland for the summer. Overall summer mortality is about 23% in the lambs and 4% in the ewes, and 75% of the lamb predation by red fox, wolvenrine, golden eagle and lynx, in Eastern Ethiopia (Warren *et al.,* 2001). Mortality tends to be higher in male lambs as they seem to be less fearful. They have shorter fleeing distances, and they graze on their own, further from older ewes maintain closer contact with their lambs, and they are more likely to position themselves between their lambs and a predator (Hutson, 2000).

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2.4.4 Foot Rot and Sheep Scab

Many sheep are kept in wetter areas (Gulelat, 2002) that favour grassland production. Diseases such as foot rot are prevalent in such conditions. The sheep limp and have difficulty in keeping up with the rest of the flock when moving. Standby and walking whilst grazing are also painful experiences. Foot rot can lead to persistent hyperalgesia and depressed production (Ley *et al.,* 1995). The foot lesions are sometimes prone to fly strike whilst sheep scab causes intense irritation. The sheep are restless: they rub themselves on fence posts, bite at their flanks and scratch themselves with their hind feet. They also produce unusual facial expressions when they scratch themselves with hind foot. There is mouthing with tongue protruding curing the scratching (Corke and Brown, 1999).

2.4.5 Endoparasites and dags

Feed intake, growth rate and weaning weights are often depressed during parasitism. When lambs infested with *Haemonchus contortus* were underfed, they developed severe anorexia,

weakness and anaemia, and some animals had to be culled (Wallace *et al.,* 1999). The appetite and growth suppressing effects of a worm burden are greater in lambs that are underfed. Trichostrongylus colibriforms may in part be caused by the effects of the lamb's own immune response rather than direct damage caused by the parasite (Greer *et al.,* 2005). Ensuring that lambs have adequate feed will help improve their resilience to established infection, but it will not necessarily improve their resistance to infection.

2.4.6 Castration and Tail docking

There is a growing public debate pertaining to routine animal husbandry practices performed on livestock farms. In sheep production, docking and castrating are practices which are increasingly being questioned by animal welfare practitioners and other interested persons. Castration is a potentially painful procedure, but it is usually done under local anaesthesia. The surgical method is considerably more painful than either the conventional rubber ring or the emasculator method, and the short scrotum ring method causes less pain and distress than the conventional ring method (Mellor and Stafford, 1999; Webb Ware *et al*., 2000). Tail docking induces considerable discomfort in young lambs. Short docking of the tail of lambs has also been linked to increased incidence of rectal prolapse (Webb Ware *et al.,* 2000).That farmers should consider the welfare of docking and castrating requires a paradigm shift for most of sheep producers. Its not that farmers should not do these practices but that they have a moral and ethical obligation to minimize the pain stress and distress that form livestock experiences while they are in their care.

2.4.7 Sheep productivity in communal areas

Sheep survival during winter in cold climates can be determined by the parasite burden at the beginning of the winter and the sheep ability to feed. In many parts of Africa sheep are

supplementary enterprise to cattle. They reproduce more rapidly than cattle, even though they experience higher mortalities. When a drought strikes, sheep are usually slaughtered before goats, because they are less hardy, they tend to show poorer recovery following droughts and they are less valued for milk production (Baars, 2000). Sheep are suitable in saltbush regions. They are more salt tolerant than other domesticated species, with the exception of the camel (Assad *et al.,* 1997; Baars, 2000). Phosphorus deficiency can cause suffering especially when it is severe and it leads to broken bones. Subclinical forms are a particular problem in some parts of the world where subsistence cattle and sheep farming are practised. Sub clinical deficiencies cause economic losses in production especially when lactation coincides with a late dry season.

2.4.8 Dog shepherding

One of the most fearful stimuli for free ranging bighorn sheep, in terms of heart rate activation, is the presence of a man with a dog. Dogs seem to elicit an inmate fear for a sheep (Telouw *et al.*, 2008). In some countries are used for controlling confined sheep, such as sheep in handling yards on farms and abattoirs. These yard dogs are usually muzzled to control biting, and they develop special skills for moving sheep. For example, backing dogs at abattoirs are trained to empty a pen of sheep by jumping over the site railings and walking on the back of the sheep to a corner where they drop to the floor and start barking. Occasionally there is an unruly dog which tries to isolate the last sheep leaving a pen, which it then tries to attack (Telouw *et al*., 2008) causing stress to sheep. Injuries are avoided by ensuring that the dogs are muzzled whilst working.

2.5 Methods of assessing nutritional and health status of sheep

Diagnosing of diseases and poor nutrition in a flock is of paramount importance to a farmer to reduce losses (Tibbo *et al.,* 2004). Methods such as body weights and condition changes are used to determine health and nutritional status of sheep.

2.5.1 Body weights and condition

Throughout the production cycle, sheep producers in communal areas must know whether or not their sheep are in condition, too thin, too fat, or just right for the stage of production like late pregnancy and lactation. Weight at a given stage of production is the best indicator, but as there is a wide variation in mature size between individuals and breeds, it is extremely difficult to use weight to determine proper condition. Body condition scoring describes the condition of a sheep, is convenient, and is much more accurate than a simple eye appraisal. Determination of health and/or nutritional status of livestock using body weights and/or condition have been reviewed by many authors (Sakkinen, 2005; Ndlovu *et al.,* 2007). A body condition score estimates a condition of muscling and fat development. Scoring is based on feeling the level of muscling and fat deposition over and around the vertebrae in the loin region (Russel, 1991). Cisse *et al.* (2002) indicated that body condition score signifies body fats more than body weight (Mannathoko, 2002; Morand-Fehr, 2003). Resource-poor farmers do not have scales for weighing their sheep; it is of necessity that research should focus on the compatibility of condition scoring as a health and/or nutritional status indicator in the communal sheep.

Ecological differences entails rainfall and temperature differences which plays a major role in fluctuation in body weight and condition at different months. Seasonal variation is a key

factor in communal areas where extensive management of sheep is directly linked to the environmental conditions (Angassa and Oba, 2007). Variation in precipitation will cause fluctuations in forage quality and quantity, forage conservation utilisation, and consequently, changes in sheep condition indices and populations and this has got influence on flock dynamics (Boone and Wang, 2007).

2.6 Summary of literature review

Sheep production in the communal areas is characterised by many constraints that include high disease and parasite prevalence, poor marketing management, shortage of extension staff on the ground, limited forage availability as well as poor sheep welfare practices. Given such constraints, it is therefore necessary to investigate them further paying much attention to geographical areas and or 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 flock sizes and productivity in a period not less than a year or more. Establishment of correlation between body weight and body condition, investigation of constraints to sheep production practices and evaluation of nutritional benefits therefore remains a prerequisite.

2.7 Reference

Abdel-Moneim, A.Y., Ahmed, A.M., Ibrahim, M.M., Mokhtar, M.M., 2009. Flock dynamics of desert barki sheep in relation to age structure. *Tropical Animal Health and Production* **41**, 899–905.

Food and Agriculture Organisation (FAO, 2005), Technical Cooperation Project No. TCP/SAF/8821(A). FAO, Rome, Italy.

Aitken, D. I., 2007. Diseases of sheep. Blackwell Publishing. United Kingdom. 610 pages.

Alexandre, G., Mandonnet, N., 2005. Goat meat production in harsh environments. *Small Ruminant Research* **60,** 53-66.

Angassa, A., Oba, G., 2007. Relating long-term rainfall variability to cattle population dynamics in communal rangelands and a government ranch in southern Ethiopia. *Agricultural Systems* **94**, 715-725.

Assed, F., Bayoumi, M.T., Khamis, H.S., 1997. Impact of long – term Administration of Saline Water and protein shortage on the hemograms of Camel and Sheep. *Journal of Animal Environments* **37,** 72 – 81.

Baars, R.M.T., 2000.Costs and returns of camels, cattle and small ruminants in pastoral herds in Eastern Ethiopia. *Tropical of Animal Health Production* **32**, 113-126.

Bakshi, M. P. S., Wadhwa, M., 2007. Tree leaves as complete feed for goat bucks. *Research* **69,** 1-3.

Bayer, W., von Lossau, A., Feldmann, A., 2001. Smallholders and community-based management of farm animal genetic resources. Proceedings of the workshop held in Mbabane, Swaziland, 7-11 May 2001. Food and Agriculture Organisation of the United Nations Rome, 2003.

Ben Salem, H., Smith, T., 2008. Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Research* **77,** 174-194.

Benson, G., Miller, D., Lichtenwalner, R., 2001. Beef cattle marketing in North Carolina: http://www2.ncsu.edu/unity/lockers/project/arepublication/AREno32.pdf (Accessed on the 25 November 2009).

Botsime, B.D., 2006. Influence of Agro-Ecological Region on Selected Anthropometrical Measurements of Nguni of Nguni in South Africa, PhD Thesis, University of Pretoria, South Africa.

Boone, R.B., Wang. G., 2007. Cattle dynamics in African grazing systems under variable climates. *Journal of Arid Environments* **70** (3), 495-513.

Braker, M.J.E., Udo, H.M., Webb, E.C., 2002. Impacts of intervention objectives in goat production within subsistence farming. *South African Journal of Animal Science* **32,** 185-191.

C.I.A – The World Fact Book 2005. Ethiopia. World Bank. URL. (Web accessed on 20 April 2006):http//www.ciagov/cia/publications/factbook/goes/et.html).

CAPEWOOLS SA., 2007. Regional analysis of wool production in Southern Africa 1999/00. Cape Wools SA, South Africa, Port Elizabeth.

Chambers, R., Pacey, A., Thrupp, L. A., (Eds.) 1989. Farmer First: Farmer Innovation And Agricultural Research. London: Intermediate Technology Publications.

Chiduwa, G., Chimonyo, M., Haliman, T.E., Chisambara, S.R., Dzama, K., 2008. Herd Dynamics And Contribution Of Indigenous Pigs To The Livelihoods Of Rural Farmer In A Semi – Arid Area Of Zimbabwe. *Tropical Animal Health and Production* **40** (2), 125-136).

Chiejina, S., Fakae, B., Behnke, J., Nnadi, P., Wakelin, D., 2002. Expression of acquired immunity to a local isolates of *Haemonchus contortus* by the Nigerian West African Dwarf (WAD) goat. *Veterinary Parasitology* **104,** 229-242.

Chikagwa-Malunga, S.K., Banda, J.W., 2006. Productivity and survival ability of goats in smallholder crop/livestock farming systems in Malawi. Livestock Research for Rural Development.

Cisse, M., Ly, I., Nianogo, A. J., Sane, I., Sawadogo, J. G., N'Diaye, M., Awad, C., Fall, Y., 2002. Grazing behaviour and milk yield of Senegalese Sahel goat. *Small Ruminants Research* **43,** 85-95.

Corke, M.I., Brown, D.M., 1999. The Behaviour of Sheep with Seab, Psoroptes ovis infection. *Veterinary Parasitology* **83**, 291 – 300.

de Sherbinin, A., Van Wey, L. K., McSweeney, K., Aggarwal, R., Barbieri, A., Henry, S., Hunter, L. M., Twine, W., Walker, R., 2008. Rural household demographics, livelihoods and the environment. *Global Environmental Change* **18,** 38-53.

de Vries, J., 2008. Goats for the poor: some keys to successful promotion of goat production among the poor. *Small Ruminants Research* **77,** 221-224.

Desta, L., Kassie, M., Benin, S., Pender, J., 2000. Land degradation in the highlands of Amhara region and strategies for sustainable land management. In: Jabbar, M.A., Pender, J. & Ehui, S.K. (eds). Policies for sustainable land management in the highlands of Ethiopia: Summary of papers and proceedings of a seminar held at ILRI, Addis Ababa, Ethiopia, 22–23 May 2000. Socio-economics and Policy Research Working Paper 30. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Ellery, W.N., Scholes, R.J., Sscoles, M.C., 1995. The distribution of sweet-veld in South Africa's grassland biome in relation to environmental factors. *African Journal of Range and Forage Science* **12**, 38-45.

Ferrington, J., 1994. Organisational Rules in farmer participatory research and extension: Lesson from the last decade. Manage – ODI Natural Resources Perspectives no. 27. January 1998.

García-Torres, L., Benites, J., Martinez-Vilela, A., Holgado-Cabrera, A., 2003. Conservation agriculture: environment, farmers experiences, innovations, socio-economy, policy. The hot-dry seasoner, United Kingdom.

Githiori, J. B.; Athanasiadou, S., Thamsborg, S. M., 2006. Use of plants in novel approaches for control of gastrointestinal helminths in livestock with emphasis on small ruminants *Veterinary Parasitology* **139,** 308-320.

Greer, A.W., Stankiewilcz, M., Jays, N. P., Mc Anulty, R.W., Sykes, A.R., 2005. The effect of concurrent corticosteroid induced immune – suppression and infection with the intestinal parasite Trichostongylus colubritormis on food intake and utilization in both immunologically naive and competent sheep. *Animal Science* **80**, 89 – 99.

Gulelat, W., 2002.Household herd size among pastoralists in relation to overstocking and rangeland degradation (Sesfontein, Namibia). MSc. Thesis. International Institute for Geo-information Science and Earth observation, Enschede, The Netherlands, pp.1-82.

Haenlein, G. F. W., Ramirez, R. G., 2007. Potential mineral deficiency on arid rangelands for small ruminants with special reference to Mexico. *Small Ruminants Research* **68,** 35-41.

Hall, D.G., Fogarty, N.M., Gilmous, A.R., 1995 Performance of Cross Breeds progeny of Trangie Fertility Merino and Booroola Merino rams and Poll Dorset ewes. 1. Lamb Birth Weight, Survival and growth. *Australian Journal of Experimental Agriculture* **35**, 1069 – 1074.

Hobbs, J.E., 1997. Producers attitudes towards marketing channels for finished cattle, Farm Management **9** (11) (1997), pp. 566–579.

Hobbs, J.E., 1996. A transaction cost approach to supply chain management, Supply Chain Management **1** (1996), pp. 15–27. Full Text via Cross Ref View Record in Scopus Cited By in Scopus (46).

Holst, P.J., Hegetarty, R.S., Fogarty, N.M., Hopkins, D.L., 1997. Fibre Metrology and physical characteristics of lambskins from large Merino and Cross breed lambs. *Australian Journal of Experimental Agriculture* **37,** 509 – 514.

Homman, S., van Rooyen, A., Moyo, T., Nengomasha, Z., 2007. Goat Production and Marketing: Baseline Information for Semi Arid Zimbabwe, Bulawayo, Zimbabwe: International Crops Research Institute for the semi arid tropics. http.//www.cipav.org.co/irrd/irrd17/10/map17115.htm.acessed:04/11/2005.

Hutson, G.D., 2000. Behavioural principles of sheep handling. In: Grandin, T. (Ed.), Livestock Handling and Transport. CABI Publishing, pp. 175-200.

Kosgey, I.S., 2004. Breeding objectives and breeding strategies for small ruminants in the tropics. Ph.D. Thesis, Wageningen University, The Netherlands, 272 pp. (also available from http://www.library.wur.nl).

Kusina, N.T., Kusina, J., 1999. Goat productivity in Zimbabwe: opportunities and constraints – A review. Proceedings of the Association of Institutions of Tropical Veterinary Medicine (AITVM) in association with Zimbabwe Veterinary Association (ZVA), 14–18 September 1998, Harare, Zimbabwe.

Lebbie, S.H.B., 2004. Goats under household conditions. *Small Ruminant Research* **51,** 131-136.

Ley, S.J., Waterman, A.E., Livingston, A., 1995. A field study of the effect of lameness of mechanical no receptive thresholds in sheep. *Veterinary Records* **137**, 85 – 87.

Lovelace, C.E.A., Vaz, Y., Mukuka, J., Simukoko, H., Chitambo, H., 2000. The marketing chain for goats from farms in the Zambezi valley of Zambia. In Improvement of market orientated small ruminant production systems and sustainable land use in semi-arid regions of Southern Africa (pp. 132–146). Project TS3-CT94-0312 Final Technical Report.

Lowe, T.E., Gregory, N.G., Fisher, A.D., Payne, S.R., 2002. The effects of temperature elevation and water deprivation on lamb physiology, welfare and meat quality. *Australian Journal of Agricultural Research* **53**, 707 – 714.

MacRea, J.C., 1993. Metabolic consequences of internal parasitism. In: *Proceedings of Nutrition Society* **52**, 121–130.

Mahanjana, A.M., Cronjé, P.B., 2006. Factors affecting goat production in a communal farming system in Eastern Cape region of South Africa, *South African Journal of Animal Science* **30,** 149–154.

Mahusoon, M.M., Perera, A.N.F., Perera, E.R.K., Perera, K.A., 2004. Effect of molybdenum supplementation on circulating mineral levels, nematode infection and body weight in goats as related to season. *Tropical Agricultural Research* **16,** 128-136.

Mannathoko, G.G., 2002. The effects of castration on live weight and carcass composition of indigenous Tswana goats. Part II. Dissertation submitted in partial fulfillment of Diploma in Animal Health and Production. Botswana College of Agriculture. Botswana.

Mapiye, C., Sibanda, S., 2005. Constraints and opportunities of village chicken production systems in the smallholder sector of Rushinga District of Zimbabwe.

Mapiye, C., Chimonyo, M., Dzama, K., 2009. Seasonal dynamics, production potential and efficiency of cattle in the sweet and sour communal rangelands in South Africa. *Journal of Arid Environments* **73**, 529-536.

Mc Neil, D.M., R.W., Williams, I.H., 1999. Maternal Fatness influences fetal size in ewes underfed in late pregnancy. *Australian Journal of Agriculture Research* **50**, 1171 – 1177.

Mellor, D., Stafford, K., 1999. Assessing and minimising the distress caused by painful husbandry procedures in ruminants. *In Practice* **21**, 436 – 446.

Moll, H.A.J., Staal, S.J., Ibrahim, M.N.M., 2007. Smallholder dairy production and markets: a comparison of production systems in Zambia, Kenya and Sri Lanka. *Agricultural Systems* **94,** 593 - 603.

Morand-Fehr, P., 2003. Dietary choices of goats in the trough. *Small Ruminants Research* **49,** 231–239.

Morand-Fehr, P., Boutonnet, J.P., Devendra, C., Dubeuf, J.P., Haenlein, G.F.W., Holst, P., Mowlem, L., Capote, J., 2004. Strategy for goat farming in the 21st century. *Small Ruminants Research* **51,** 175-183.

Muchadeyi, F.C., Sibanda, S., Kusina, N.T., Kusina, J., Makuza, S.M., 2005. Village Chicken Flock Dynamics and Contribution of Chickens to Household Livelihoods In A Small Farming Area In Zimbabwe. *Tropical Animal Health and Production* **37,** 333 – 334.

Mulume, C. G., Wollny, C. B. A., Banda, J. W., Phoya, R. K. D., 1999. Performance of local pigs under village conditions in the rural area in Malawi. In Proc. 50th EAAP Conference, 22 – 26 August 1999, Zurich, p. 288.

Mwale, S. E., Wollny, C., Banda, J. W., Chagunda, M. G. G. and Bruns, E., 1999. Evaluation of Malawi Zebu and its crosses on Smallholder dairy farms in Mzuzu, Northern Malawi. Tropentag 1999. Humboldt University of Berlin, 14 – 15 October 1999.

Ndlovu, T., Chimonyo, M., Okoh, A. I., Muchenje, V., Dzama, K., Raats, J.G., 2007. Assessing the Nutritional Status of beef cattle: current practices and future prospects. *African Journal of Biotechnology* **6** (24), 2727-2734.

Newton, T. H., 1995. Sheep Production Research: The Development of Small Ruminants in the Developing Countries. Small Ruminants in African Agriculture, pp 128-141.

Nkhori, P.A., 2004. The impact of transaction costs on the choice of cattle markets in Mahalapye district, Botswana. MSc Dissertation, University of Pretoria, Pretoria.

Papachristou, T.G., Luthando, E.D., Frederick, D.P., 2005. Review article: Foraging ecology of goats and sheep on wooded rangelands. *Small Ruminant Research* **59,** 141–156.

Peacock, C., 1996. Improving goat production in the tropics. Manual for development workers, (Oxfarm/Farm-Africa Publication, UK and Ireland).

Peacock, C., Devendra, C., Ahuya, C., Roets, M., Hossain, M., Osafo, E., 2005. Livestock and wealth creation: Improving the husbandry of animals kept by resource-poor people in developing countries. In: Owen, E., Kitalyi, A., Jayasuriya, N.and Smith, T. (eds),. Nottingham University Press, Nottingham, UK. pp 361-385.

Perret, S.R.., Mercoiret, M.R., (Eds.) 2003. Supporting Small-Scale Farmers And Rural Organisations: Learning From Experiences In West Africa. Pretoria: Protea Book House, Ifas and Cirad.

Pound, B., Snapp, S., Mcdougall, C., Braun, A., 2003. Managing Natural Resources For Sustainable Livelihoods: Uniting Science And Participation. London: Earthscan Publications.

Quinn, C.H., Huby, M., Kiwasila, H, Lovett, J.C., 2007. Design principles and common pool resource management: An institutional approach to evaluating community management in semi-arid Tanzania. *Journal of Environmental Management* **84,** 100–113.

Raghuvansi, S.K.S., Tripathi, M.K., Mishra, A.S., Chaturvedi, O.H., Prasad, R., Saraswat, B.L., Jakhmola, R.C., 2007. Feed digestion, rumen fermentation and blood biochemical constituents in Malpura rams fed a complete feed-block diet with the inclusion of tree leaves. *Small Ruminant Research* **71,** 21-30.

Reij, C., Waters-Bayer, A., 2001. Farmer Innovation In Africa: A Source Of Inspiration For Agricultural Development. London: Earthscan Publications.

Rhind, S.M., Reid, H.W., McMillen, S.R., Palmarini, G., 1998. The Role of Cortisol and B – Endorphin in the Response of the Immune System to Weaning In Lambs. *Animal Science* **66**, 397 – 468.

Russel, A., 1991. Body Condition Scoring of Sheep in: E. Boden (Ed.) Sheep and Goat Practice, pp3. Bailliere Tindall, Philadelphia.

Sakkinen, H., Tornberg, J., Goddard, P.J., Eloranta, E., Dahl, E., Ropstal, E., Saarela, S., 2005. Adrenal responsiveness of reinder (Rangifer tarundus tarundus) to intravenously administered ACTH. *Animal Science* **81**, 399-402.

Scoones, I., Thompson, J., (Eds.) 1994. Beyond Farmer First: Rural Peoples' Knowledge, Agricultural Research and Extension Practice. London: Intermediate Technology Publications.

Seleka, T.B., 2001. Determinants of short-run supply of small ruminants in Botswana. *Small Ruminants Research* **40,** 203-214.

Simela, L., Montshwe, B.D., Mahanjana, A.M., Tshuwa, M.P., 2006. The Livestock Production environment in the South African small holder sector. New challenges for the animal science industries. SASAS 41st Congress Abstracts, pp 66.

Sissay, M.M., Asefa, A., Uggla, A., Waller, P.J., 2006. Anthelmintic resistance of nematode parasites of small ruminants in eastern Ethiopia: exploitation of refugia to restore anthelmintic efficacy. *Veterinary Parasitology* **135,** 337–346.

Sowinska, J., Brzostowski, H.,Tanski, Z., Czaja, K., 2001. The weaning stress response in lambs of different age. *Czech Journal of Animal Science* **46**, 465 – 468.

Sundquist, B., 2003. "Grazing Land Degradation: A Global Perspective." Online Article.http://home.alltel.net/bsundquist1/og0.html. (Accessed 11/2004).

Terlouw, E.M.C., Arnould, C., Auperin, B., Berri, C., Le Beihan-Duval, E., Deiss, V., Lefevre, F., Lensink, B.J., Mounier, L., 2008. Pre - slaughter conditions, animal stress and welfare: current status and possible future research, *Animal* **2**, 1501 – 1517.

Tibbo, M., Jibril, Y., Woldemeskel, M., Dawo, F., Aragaw, K., Rege, J.E.O., 2004. Hematological profiles in three Ethiopian indigenous goat breeds. *International Journal of Applied Research of Veterinary Medicine* **2,** 297-308.

Wallace, D. S., Barden, K., Duncan, J.L., Eckersall, P.D., Fishwick, G., Holmes, P.H., Mc Kellar, Q. A., Mitchell, S., Murray, M., Parkins, J.J., Stear, M.J., 1999. The Influence of increased feeding on the susceptibility of to infection with Haemonelus Contortus. *Animal Science* **69,** 457 – 463.

Warren, J.T., Mysterud, I., Lynnebekken, T., 2001. Mortality of Lambs in Free-ranging domestic sheep (*Ovis aries*) in Northern Norway). *Journal of Zoology* **254,** 195 – 202.

Webb Ware J.K., Vizard A.L., Lean G.R., 2000. Effects of tail amputation and treatment with an albendazole controlled-release capsule on the health and productivity of prime lambs. *Australian Veterinary Journal* **78**, 838-842.

CHAPTER 3: Production practices and constraints to sheep productivity in ecologically different communal areas

Abstract

The objective of the current study was to determine the production practices and constraints to sheep productivity in ecologically different communal areas. A total of 100 structured questionnaires were administered. Direct observations, participatory techniques were also employed to capture data from 67 farmers in Gaga and 33 from Sompondo communal villages. Most (70%) of sheep owners were men and were more involved in sheep flock management than adult females and youths. Mean sheep flock sizes per household were not significantly different between the two villages; Sompondo (18.3 ± 3.10) and Gaga (19.0 ± 3.10). There were significance negative correlation ($r = -0.61$ for Sompondo, $r = -0.55$ and Gaga; $p > 0.05$) between sheep flock sizes and cattle herd sizes kept per household. Shortage of feed and diseases/parasites were ranked by farmers as the most important constraints. In both villages, sheep houses were poorly constructed. Most mortalities were caused by heart water, gall sickness and foot rot. Fewer farmers owned rams, 39 % in Sompondo and 36 % in Gaga. Dohne Merinos were the common genotypes in the communal areas. Breeding season was undefined and mating system was largely uncontrolled in the villages. Differences in agro-ecological conditions, specific social and economic conditions at household level, constraints like shortage of feed, diseases/parasites need to be considered when designing sheep improvement and management programmes.

Key words: rams, feed shortage, flock management, mortalities, household

3.1 Introduction

South Africa has approximately 25 million sheep and 25% of these are raised by communal farmers of Eastern Cape and Free State (CAPEWOOLS S.A., 2007). Sheep play an important role in both commercial and subsistence farming systems and in South African livestock industry in general (Brundyn *et al*., 2005). In South Africa, sheep are widely distributed across the country where they are or expected to contribute to the livelihoods of the rural population as a source of protein, wool, food security and poverty alleviation (Gatenby, 1986; Shackleton, 1995; Bayer *et al.,* 2001).

The relative roles of sheep to a communal farmer varies from economic products, by-products, risk mitigation, property security, capital (Braker *et al*., 2002), cultural uses and prestige (Shackleton, 1995; Bayer *et al.,* 2001). However, all these roles vary with production system, agro-ecological region, rangeland type, cultural values and socio-economic status of the farmer (Chimonyo *et al.,* 1999; Botsime, 2006; Simela *et al.,* 2006). Rainfall pattern and vegetation type determines the rangeland type and in South Africa there are sweet and sour rangelands. Sour rangelands receive between 600 and 800mm of rainfall per annum and are mainly composed of annual grass species, which lose nutritive value and palatability during the dry season (Ellery *et al*., 1995). The sweet rangeland, in contrast with sour rangeland, precipitation is less than 500mm per annum and vegetation is comprised of perennial grasses that remain nutritious and palatable through out the year (Ellery *et al*., 1995).

Constraints faced by communal farmers are not uniform across production systems (Botsime, 2006; Nqeno *et al.,* 2009). Adoption of on-farm level recommendation depends upon the social, cultural, economic and environmental conditions facing the farmers who

own and use livestock (Verbeek *et al*., 2007; Nqeno *et al*., 2009. To produce a viable and sustainable developmental programme for the resource-limited farmers these challenges and differences need to be understood. The information generated can act as a data base and can also assist policy makers to come up with sheep mitigation measures. The objective of this study was, therefore, to determine sheep production practices and constraints in two ecologically different areas. The null hypothesis tested was that there is no difference in sheep production practices and constraints in the two ecologically different villages.

3.2. Materials and Methods

3.2.1. Description of the study sites

The study was conducted in Gaga and Sompondo Villages in the Amathole District Municipality of the Eastern Cape. Gaga village is located 10 kilometres west of Alice town and falls under the administration of Nkokobe Local Authority. It is situated 32˚ 17˙ E and 26˚ 55˙ S at an altitude of 450 m above sea level. It receives a mean annual rainfall of 500 mm. The highest mean temperature is recorded in January (22˚C) and lowest in July (9˚C). Most of the rains are received between November and April. It is lowland characterised with steep, isolated mountains and the veld type is predominant of False Thornveld. It is situated closer to townships surrounding Alice town. The most common grass species are *Themeda trianda, Setaria sphacelate, Microchloa caffra, Ellonurus muticus* and *Heteropogon contortus* grasses. The dominant tree species are *Acacia karroo, Scutia myrtina* and *Maytenus polyacantha* (Ellery *et al.*, 1995).

Sompondo village is located 20 km east of Alice town and it is in highland. It has a unique natural character, i.e. geographically it lies between two high mountains with angulating topography. It lies on Longitude 32˚ 07˙E and Latitude 27˚ 30˙S at an altitude of 1440 m

above sea level. The climate is semi-arid with the annual rainfall of about 800 mm, most of which occurs in summer. Mean monthly minimum and maximum day temperatures are recorded in July (11˚C) and January (20˚C), respectively. The village is relatively not closer to the townships surrounding Alice, but roads are in a relatively good condition. It is near Hogsback, a reserve dominated by 3 ridges said to resemble hog's back. Hogsback is both a tourist and leisure centre. Vegetation in Sompondo communal area is consists of *T.trianda, H. contortus, Sporobolus africanus* and *Microchloa ciliate*. *Euryops pyroides, Chrysocoma ciliate* and *Dyspyrose serabrida* (Lesoli, 2008).

3.2.2. Sampling of households

In Gaga, out of a total sample of 72 households, 33 were selected and in Sompondo 67 out of 120. Farmers in the chosen villages are known for raising sheep together with other livestock species such as goats, cattle and chickens. Samples were selected through probability sampling method and the technique chosen was simple random sampling. The method was chosen because it gives every farmer equal chances of being selected. The PROC NUMBERS procedure of SAS (2007) was used to draw farmers who constituted the samples. Administration of a structured questionnaire was done on 100 sheep growers; 33 in Sompondo and 67 in Gaga. Only those farmers, who had sheep and were willing to participate, were considered. The sheep growers were selected from a register kept by the chairperson of the Sheep Growers Association with assistance of National Department of Agriculture, Local Sheep Growers Committee and Local Leadership snowballing technique was used to select participants. The questionnaire was pre-tested for accuracy and clarity of questions.

3.2.3. Data collection

The questionnaire was designed to gather data on sheep management systems, constraints faced by resource-poor farmers, flock size, flock composition, incidence of slaughter, sales, mortalities, theft, livestock species and number kept, purpose of sheep keeping, feeding practices, health management, breeds kept and the farmers had to rank the purpose of sheep keeping as they perceived. Key informants, such as chiefs, headmen, chairpersons of the sheep growers association of South Africa, local agricultural extension officers and veterinary personnel provided secondary information on cultural beliefs, livestock species kept, aspects of sheep production and role of agriculture. At most of the homesteads direct observations were made of the sheep breeds used, grazing areas and housing structures. The questionnaire is attached on Appendix 1.

3.2.4. Statistical analysis

The PROC FREQ procedure of the Statistical Analysis Systems (2007) was employed to generate frequencies for farmer profile, participation of the different gender groups and management practices in smallholder sheep production. To determine association between sex of head of household and sheep flock sizes, a chi-square test was computed. Comparison of household demography and flock sizes between villages was done using generalised linear model (GLM) procedures of SAS (2007). Pearson's correlation generated by PROC CORR procedure of (SAS, 2007) was used to determine the strength of the relationship between flock sizes and other species like cattle and goats. Ranks of functions of sheep between villages were compared using PROC NPARIWAY (Wilcoxon test) of SAS (2007).

3.3 Results

3.3.1. Socio-economic profile of farmers

The socio-economic profiles of the respondents in Sompondo and Gaga villages are shown in Table 3.1. Most of the households were male-headed in these two villages. The mean household sizes for Sompondo and Gaga villages were 4.6 ± 0.45 and 5.6±0.32 members respectively. There were more respondents with basic education (Grade 1-7) than those with secondary and tertiary education. The majority of the interviewees in Sompondo and Gaga were unemployed and survived on pension and social grants. The greater number of farmers in Sompondo and Gaga acquired their flock through purchasing and fewer flocks were obtained through barter trading or exchange programmes and inheritance in both villages. Most of the heads of the households across the villages were resident on the farm. The majority of farmers across the villages reported that they were experiencing some sheep mortality problems.

Across the villages, the age group above 50 years were actively involved in sheep rearing. Women, boys and girls helped in the absence of men. The activities carried out by men include general health management of the flock, docking, shearing, purchasing of breeding stock, selling of wool and selling sheep. Hired labour and male youths were involved in the construction of housing and slaughtering of sheep. Women and female youths participated in assuring that the flock was kraaled during the evening.

Table 3. 1: Socio–economic characteristics, challenges and perceptions of respondents (%) on issues related to sheep production in two villages in the Eastern Cape

	Village	
Socio-economic characteristic	**Sompondo (%)**	**Gaga (%)**
Male headed households	70	54
Married respondents	67	52
Age group above 70 years	15	20
Respondents with basic education (Grade 1-7)	88	88
Respondents with secondary and tertiary education	9	12
Respondents who were living on pension	63	67
Respondents resident on the farm	85	73
Farmers experiencing sheep mortality problems	97	91
Respondents without children	33	36
Farmers experiencing feed shortage	64	61
Farmers who do not keep records	82	96
Female farmers owning sheep	29	46
Male farmers owning sheep	64	54
Mixed (both males and females) owning sheep	7	0
Respondents who did not flock dip	67	93
Farmers who did not deworm	58	91
Respondents who acquired their sheep through purchasing	90	80
Farmers who got their flock through barter trading or exchange	3	2
Respondents who acquired their flock through inheritance	12	28

The majority of the farmers across the villages neither flock-dipped nor dewormed their sheep. Most of the respondents in Sompondo and Gaga did not keep records of their sheep. More than half of the respondents in the two villages experienced feed shortages. In Sompondo village (79 %) and Gaga (28 %) of the respondents acknowledged receiving assistance from sheep growers association in marketing and selling of their wool but none in selling of their sheep.

3.3.2. Sheep flock composition and their importance to the farmers

Sheep was ranked as the most important livestock species kept by the farmers, and then followed by cattle, goats and chicken (Table 3.2). Flock size was larger ($p<0.05$) in Gaga than in Sompondo village (Table 3. 2). Sheep flocks were mainly composed of ewes in both villages. As shown in Table 3.3, there were significant negative correlations ($p<0.05$) between cattle herd size and sheep flock size in both villages. Sheep and goat flock sizes were negatively correlated in Gaga village. The correlation between sheep and chicken was poor in the two villages (0.09 for Sompondo and 0.06 foe Gaga respectively)Sheep and chicken flock sizes were however not correlated in the two villages. Farmers gave various reasons for keeping sheep (Table 3. 4). Most of the respondents across the two villages ranked cash as the most important reason why they keep sheep. However, farmers in Sompondo village ranked savings and investments as the second important reason of rearing sheep whereas in Gaga consumption was ranked second. Farmers in Gaga village attached more importance on socio-cultural ceremonies whereas farmers in Sompondo valued manure as more important ($p<0.05$). Farmers in both villages placed the same importance on pride and status.

Table 3. 2: Mean flock herd sizes of livestock species kept and sheep flock composition in two villages in the Eastern Cape Province.

	Herd/Flock size	
	Village	
	Sompondo	**Gaga**
Livestock Species		
Cattle	1.9 ± 0.16	2.1 ± 0.12
Sheep	18.3 ± 3.10	19.0 ±3.10
Goats	3.1 ± 0.14	2.8 ± 0.11
Chickens	3.6 ± 0.10	3.5 ± 0.11
Flock composition		
Ram	0.8 ± 0.29	0.6 ± 0.15
Ewe	7.7 ± 1.64	8.5 ± 1.42
Lamb	5.4 ± 1.20[a]	4.5 ± 0.93[b]
Gimmer	2.2 ± 0.45[a]	3.1 ± 0.84[b]
Wither	2.2 ± 0.44	2.3 ± 0.52

[ab]Values with different superscripts, within a row, are statistically different ($p<0.05$)

Table 3. 3: **Pearson's correlation coefficient of numbers between different livestock species kept by sheep owners in two villages in the Eastern Cape Province**

Livestock species		Village	
		Sompondo	**Gaga**
Cattle			
	Sheep	-0.61*	-0.55**
	Goats	-0.55**	-0.14
	Chicken	-0.29	-0.37*
Sheep			
	Goats	-0.06	-0.36*
	Chickens	0.09	0.06
Goats			
	Chickens	-0.43	-0.44

Values with an asterisk show statistically correlations at ($p<0.05$) for * and $P<0.01$ for **

Table 3. 4: Ranking of reasons for keeping sheep in Sompondo and Gaga Villages

Function	Sompondo		Gaga		Significance
	Rank	Mean rank	Rank	Mean rank	
Raise income	1	2.36	1	2.27	NS
consumption	3	3.21	2	2.68	NS
Saving and investment	2	2.70	3	2.71	NS
Manure	4	3.30	6	4.80	*
Socio-cultural	6	4.97	4	2.93	*
ceremonies					
Status	5	4.42	5	4.46	NS

The lower the rank of a reason, the greater is its importance.

NS = not significance

*Significant at $P < 0.05$

3.4 Sheep production constraints

Diseases and parasites were ranked as the primary constraint in both villages. Marketing of sheep was ranked as a second and third constraint in Sompondo and Gaga respectively. The third most important constraint in Sompondo village was theft while in Gaga the same constraint was ranked second. Feed shortage was ranked as fourth constraint in Sompondo and seventh in Gaga village. The fifth most important constraint in both villages was poor housing. In Sompondo, lack of capital was ranked as a sixth constraint and the same constraint was ranked in Gaga as a fourth constraint. Disease and parasites were ranked as the most important constraint in the two villages, while lack of knowledge was ranked as seventh most important constraint in Sompondo and sixth in Gaga (Table 3.5).

Logistic analysis revealed that households with educated heads of household had less ($P < 0.05$) chances of facing challenges of feed shortages than those headed by uneducated heads of households. The logistic analysis also showed that Male headed households were less ($P < 0.05$) prone to diseases and parasites than those ones which were headed by females. Most of the interviewees (66% in Sompondo village and 92% in Gaga village) neither dipped nor vaccinated their flock. They cited lack of funds to purchase medicines as the biggest challenge. However these farmers (100%) acknowledged using ethno – veterinary medicine in curing their flocks. *Aloe vera* was the medicine mainly used by farmers. Foot rot, gall sickness and heart water were ranked as the most common diseases by the respondents.

Table 3. 5: Sheep production constraints as ranked by respondents in Gaga and Sompondo in the Eastern Cape Province

Constraints	Rank (mean)[a]		
	Village		
	Sompomdo	Gaga	Sig*
Feed Shortage	4 (4.24)	7 (5.53)	*
Diseases and parasites	1 (1.03)	1 (1.45)	*
Inadequate marketing services	2 (3.70)	3 (3.60)	ns
Poor housing infrastructure	5 (4.70)	5 (4.64)	ns
Lack of capital	6 (4.72)	4 (4.63)	ns
Lack of production skills or knowledge	7 (5.72)	6 (5.09)	ns
Thefts	3 (3.79)	2 (2.94)	*

[a] The lower the rank of a constraint, the greater is its importance.

Sig= Significance level

*Significant at $p<0.05$

3.5 Communal sheep breeding practices

Most of the farmers preferred crossbreeds (90 % in Sompondo village and 76 % in Gaga village) and the main reasons for choosing crossbreeds were disease resistance and low feed cost. Wool quality was also ranked as the most important trait in both villages. High growth rate was the main reason for choosing a breed in both villages. Farmers in all villages attached little value on sheep colour when choosing sheep breeds (Table 3.6).

Table 3. 6: Sheep breed breeding stock selection criteria used by respondents in two villages of the Eastern Cape Province of South Africa

	Rank (mean rank)[a]		
	Village		
Criteria	**Sompondo**	**Gaga**	**Sig[1]**
Breed			
Wool quality	1 (2.09)	1(1.72)	ns
Meat quality	2 (2.30)	2 (2.63)	ns
High growth rate	3 (2.88)	3 (2.81)	ns
Disease resistance	4 (3.79)	4 (3.22)	*
Low feed cost	5 (3.97)	5 (5.22)	*
Availability	6 (6.33)	6 (6.18)	ns
Colour	7 (6.45)	7 (6.22)	ns

[a]The lower the rank, the greater is its importance of the parameter

*significance at $p<0.05$

[1]Sig = significance

3.5 Discussion

Most of the households were male-headed. This is in agreement to findings reported by Kunene and Fossey (2006) in Northern Kwa-Zulu Natal where most of the households were headed by male and fewer households were headed by widows or wives of migrants. Most of the respondents had either received lower primary, higher primary, high school qualification or tertiary education. This is in sharp contrast to findings reported by Kunene and Fossey (2006) in Northern Kwa-Zulu Natal where only one farmer was reported to have attained tertiary education and above half had not attained either primary or secondary level of education.

Sheep were reported to be used for functions such as consumption, income generation, cultural use, manure and investment. All the farmers in the two villages slaughtered and consumed the sheep during cultural ceremonies. The fact that farmers slaughtered sheep for consumption concurs with what was reported by Bembridge (1984) in rural Transkei and in Swaziland. This study agrees with Kunene and Fossey (2006) who reported versatile use of sheep to provide meat and wool for households as source of income.

Maintaining and improving a good breeding stock (Tibbo, 2006) is an important element to sheep management. However, observation made in this study is that, most farmers in these communal areas don't have rams. Ewes dominated the flocks. The findings from this study indicate that farmers in Sompondo and Gaga villages did not separate breeding ewes from rams. There was also an indication that the farmers did not make use of breeding seasons nor implement selective mating. The disadvantage of uncontrolled breeding practise, however, is that selection cannot be practiced therefore assortative and non assortative mating occurs (Sölkner *et al.*, 2001.

Under controlled mating, lambing could coincides with periods of better feed availability or planned supplementary feeding. Low numbers of breeding rams observed in the two villages could be attributed to lack of knowledge and appreciation of the importance of keeping the breeding rams by Sompondo and Gaga sheep farmers. In most of the flocks with a breeding ram, Sompondo and Gaga, the proportion of the males to females was very high; this therefore increases the chances of rams mating their relatives. Many farmers in the two villages did not realise the value of owning and maintaining breeding rams (Berhanu and Avnalem, 2009), as they could not control access to their rams. Instead, they tend to castrate the males in their flocks, as a measure of reducing straying or improving meat quality. Farmers in Sompondo and Gaga cull their sheep, but this is mainly due to old age or poor condition, which does not improve the breeding quality. Shortage of rams in the two villages has the negative impact on flock size. Therefore farmers' participation in programmes like ram exchange should be strengthened to reduce inbreeding in Sompondo and Gaga. In the current study, the findings that large stock like cattle, sheep and goats were owned by men in both villages whereas women owned small species like chickens which are mostly found close to the homesteads also concurs with observations by other authors.(Grandin *et al*., 1991; Bank and Qambata, 1999; Andrew *et al*., 2003).

In this study, the finding that households headed by females in both Sompondo and Gaga were prone to feed shortages and disease and parasites can be attributed to lack of accessibility to the credit facilities and lack of capital, poor technical skills and lack of access to extension services as observed elsewhere by Bank and Qambata (1999). Women are more affected by these aforementioned factors more than men hence it limits their participation and efficiency in sheep production.

Most of the respondents were pensioners in the two villages. Hence, the technologies meant to improve agricultural production might not be well received by the aging population (Agwu *et al.*, 2008). Younger farmers are regarded as more receptive to new farming methods and they are likely to take up the risk in implementing such new methods. Some young people perceive farming methods in communal areas as outdated and prefer formal employment in nearby urban areas (Starkey, 1996). If such perceptions are not corrected they may be a serious knowledge gap that will require a lot of attention to avoid the collapse of smallholder farming. This calls upon agricultural stakeholders and policy makers to conscientise the youth to take up vast opportunities from their elders in agriculture specifically communal farming. Findings that farmers in Sompondo and Gaga not only concentrate on sheep alone, but were involved in cattle, goats, and chicken ownership as well are an important feature for most African communal farmers as observed in other studies (Mashatise *et al.*, 2005). This is very important because diversification averts risks and promotes sustainable development in the two ecologically different communal areas. The integration of sheep with other enterprises observed in the two villages indicates a way of diversification in order to improve food security.

Cattle and sheep can be herded together in these two ecologically different villages using the same resources of labour hence realising a negative correlation between sheep and cattle sizes in all the villages. As the number of sheep increases the number of cattle decreases. Sheep and goats do coexist on same grazing area, since goats are browsers while sheep are grazers these lucrative enterprise complement each other in Sompondo and Gaga. Indigenous sheep and goats, in developing countries are important for subsistence and socio-economic livelihoods of rural and peri-urban communities (Dovie *et al.*, 2006; Kunene and Fossey, 2006; Kosgey and Okeyo, 2007).

The observation that farmers in the two villages ranked reasons for rearing sheep differently suggest different perceptions and value each village attached to sheep. Sheep associates well with crop production for its manure can be applied to crops and small gardens while in return sheep may feed on crop residues. The findings that sheep produce manure for fertilization are in agreement with those of Devendra (1992), who reported that sheep have a social-economic relevance and social-cultural roles and they produce manure to fertilize the land. Sheep manure was regarded more important in Sompondo village than in Gaga village and this is mainly attributed to the fact that there were more sheep in Sompondo village than cattle. Farmers in Gaga village applied cattle manure in the absence of fertiliser. In addition, more cropping was done in Sompondo village than Gaga village such that farmers in Sompondo made use of readily available sources of nutrients for their crops.

The finding that most farmers in Sompondo and Gaga housed their sheep in open kraal means that they lacked the resources and awareness that appropriate shelter can prevent many diseases and reduce mortality rates especially for lambs in the two ecologically different communal areas. Lambs which are often born in cold or wet conditions, have low fat cover and have a high surface area to birth weight ratio, which exacerbates heat loss (Stephenson *et al.*, 2001). Such lambs become highly vulnerable to cold and wet periods. Footrot is a common problem during the wet season when sheep are housed in muddy or water logged conditions. Higher incidences of footrot observed in highland rangeland (Sompondo) compared to lowland rangeland (Gaga) could be attributed to high rainfall received in this area. Dry and well ventilated house has been proven as a method of reducing deaths during wet season (Adak *et al.*, 2005). Many farmers in the two villages also seem to be unaware that very effective sheep shelters can be built from local materials

costing little more than the price of labour. Proper housing in the two ecologically different villages would protect animals against wind, cold, disease risks, rain and muddy conditions, which prevail during rainy season (Adak *et al.,* 2005). Farmers in the two villages should therefore be highly encouraged to provide well drained floors and provide roofs in their kraals to reduce kid mortality during the rainy season.

Most of the farmers, in the two villages reported having a problem of high tick infestation and tick-borne diseases especially during summer. This finding is in agreement with Perrett *et al.* (2000) and Marufu *et al.* (2010) in cattle. The reason being that Eastern Cape Province due to its proximity to the coast, is characterized by the semi-arid climatic conditions which are favourable for growth of tick species especially during rain season (Muchenje *et al*., 2008; Marufu *et al*., 2010). High prevalence of parasites could be attributed to uncontrolled communal grazing system practised by the communal farmers where flocks from different households, graze together and mate irregardless of their health status. This is compounded by lack of proper disease and parasites control infrastructure in the communal areas. These promote prevalence of disease and parasites under the communal production systems (Marufu *et al*., 2010). Adoption of local indigenous breeds like Dohne Mmerino, Damara and Zulu which are resistance to ticks and tick-borne diseases will go a long way in alleviating some of the problems hence can assist in improving the livelihood of the rural poor (Morad-Fehr and Boyazoglu, 1999; Devendra, 2001).

Farmers should also be made aware that they need to dip and vaccinate their sheep in order to reduce disease incidences. Housing management should also be improved so as to reduce pathogenicity. Farmers in the two villages perceive usage of locally available ethno-veterinary medicine such as *Aloe* as the best way of controlling ticks. However, research on

the efficiency, dosage rates, and application methods need to be validated. Application of train and visit methods of veterinary extension to farmers would result in improved disease diagnosis and ultimately improved animal health husbandry.

The high theft incidences reported in the Gaga village can be accredited to proximity of the village to Alice town and its surrounding townships, where there is a ready market for the mutton meat. Marketing channels of stock made it easer to trade in stolen stocks (Dzimba and Matooane, 2005). Lack of sheep identification and poor conviction and prosecution of sheep rustlers attributes to increased sheep thefts in the lowland (Gaga) whereas in upland (Sompondo) due to distance and terrain, sheep thefts were lesser. To reduce sheep thefts, community members should take turns to flock sheep during the day and kraal them at night. Formation of neighbourhood watch committees to patrol the villages during the evening can help (Kynoch and Ulicki, 2001). Awareness on importance and methods of sheep identification by Department of Agriculture should be strengthened to the farmers so that it can assist farmers to trace their animals. Law enforcement agents should also augment farmers' efforts by carrying out regular day and night patrols in the village.

The observation is that farmers in the two ecologically different communal areas had a handicap in accessing information on sheep management as well as information on markets, inputs, and service provision from various sources; most information flows were between farmers. While information flows from farmer to farmer are highly effective (Ferrington, 1994) sources of information or improved technologies are limited. Distance from town had an influence on availability of information especially sheep marketing and pricing. Farmers in the upland rarely sell their animals directly on the small ruminants market due to transport costs, the time required, and the fact that they are not in a strong bargaining

position towards the time required and the fact that they are not in a strong bargaining position towards the traders (Rodriguez, 1995). Farmers most commonly sell their sheep through the local village collector, to whom they generally have easy access. Farmers are familiar with this person who lives in the same village and sometimes is a member of a farmers group in the village. However, farmers in the lowland are slowly but surely selling their sheep direct to small vendors, retail butchers and consumers. Though farmers felt that they were not in a position to bargain efficiently, because of the frequent need of selling sheep for urgent cash requirements they had to sell thereby compromising on the pricing.

The second sources of information were government departments and non governmental organisation. However, information from these sources was generally weak and interaction was irregular. Appropriate ways of communicating with farmers across the two villages need to be found and relevant information must be made accessible to them. Information dissemination and documentation on sheep production and marketing it through the electronic and print media can be useful in improving smallholder farmers' sheep production skills if it is done in local languages. In addition, enabling farmers to use new information or knowledge also requires access to inputs: improved dry season feeds is often impossible because of a lack of genetic material, knowledge regarding growing, processing and storage of feed and duel purpose crops (Slingerland, 2000., Devendra, 2002; Dubeuf *et al*., 2004). Similarly, animal health was weakened by the lack of infrastructure in the two villages. Lebbie and Mastapha (1985), Tambi and Fomunyam (1985) and Philipsson *et al.* (2006) also observed that unavailability of dip tanks for sheep, high cost of acaricides, and other animal health care products were some of the factor affecting sheep productivity. Success in improving the current situation thus depends on greater access to information, know-how and the relevant inputs.

Stress, pain and painful husbandry procedures on management decisions have been noted in this study. The findings in this study are that there are some pain associated with husbandry procedures like tail docking, and castration. Most of the farmers in Sompondo and Gaga castrated their male lambs that are not intended for breeding using a common knife, although some few shepherds chose to avoid the procedure for ethical, economic or practical reasons. Docking, which is the shortening of a lambs tail, is practised by most of the farmers in the two villages for health reasons. However, both operations inflict pain to sheep but level of pain differs. Castration has been reported to inflict more pain than tail docking (Molony *et al.,* 2002).

3.6 Conclusions

Though the ranking of constraints faced by farmers from the two villages varied, shortage of feed and diseases/parasites were perceived to be the most important ones. Farmers keep their sheep in a free range type of grazing where there are no paddocks. According to the farmers' perception, sheep were reared for income generation. Cross breeds were the most preferred sheep breeds by farmers and the reasons being their ability to resist diseases, high growth rate and high feed conversion efficiency. Therefore, farmers' socio-economic factors and agro-ecological conditions should be considered when planning strategies for sustainable sheep breeding programmes which will alleviate poverty in communal areas. However, complexity of sheep production systems in two ecologically different communal areas calls for the determination of efficiency of sheep production systems for devising interaction strategies as a driving force towards improved sheep productivity and rural livelihood.

3.7 Reference

Adak, G.K., Meakins, S.M., Yip, H., Lopman, B.A., OlBrien, S.J., 2005. Disease risks from foods, England and wales, 1996-2000. *Emerging Infection Diseases* **11**(3), 365-372.

Agwu, A.E., Ekwueme, J.N., Anyanwu, A.C., 2008. Adoption of improved agricultural technologies disseminated via radio farmer programme by farmers in Enugu State, Nigeria. *African Journal of Biotechnology* **7,** 1277-1286.

Andrew, M., Ainsle, A., Shacketon, C., 2003. Evaluating and Agrarian Reform in South Africa Occasional Paper Series No. 8 Published by the Programme for Land and Agrarian Studies, School of Government. University of the Western Cape, Cape Town, South Africa, pp.7-13.

Bank, L., Qambata, L., 1999. No Visible Means of Subsistence: Rural Livelihoods, Gender and Social Change in Mooiplas, Eastern Cape, 1950 – 1998. Leiden, Netherlands: Africa Studie Centrum, Leiden University (ASC working paper no. 34/1999.)

Bayer, W., Alcock, R., Gilles, P., 2004. Going backwards? – Moving forward? – Nguni cattle in communal Kwazulu–Natal. "Rural poverty reduction through research for development and transformation", A Scientific Paper Presented at a Conference Held at Agricultural and Horticultural Faculty, Humboldt–Universität zu, Berlin. October 5–7, 2004 (2004), pp. 1–7.

Berhanu, B., Avnalem H. 2009. Reproductive performance of traditionally managed sheep in the south western part of Ethiopia. *Livestock Research for Rural Development* **21**,154

Botsime, B.D., 2006. Influence of Agro-Ecological Region on Selected Anthropometrical Measurements of Nguni of Nguni in South Africa, Thesis, University of Pretoria, South Africa

Braker, M.J.E., Udo, H.M.J., Webb, E.C., 2002. Impact of intervention objectives in small ruminant production within subsistence farming systems in South Africa. *South Africa Journal Animal Science* **32**, 185-191.

Brundyn, L., Brand, T.S., Fereira, A.V., Aucamp, B.B., Durand, A., 2005. The effect of frequency of supplementation on the production of South African Mutton Merino ewes grazing wheat stubble. SA-ANIM. Vol 6: Http:// www. Sassas.co.za/popular/popular.html.

CAPEWOOLS SA., 2007. Regional analysis of wool production in Southern Africa 1999/00. Cape Wools SA, South Africa, Port Elizabeth.

Chimonyo, M., Kusina, N.T., Hamudikuwanda, H.A., Nyoni, O., 1999. A Survey on land use and usage of cattle for draught in semi-arid environment. *Journal of Applied Science Southern Africa* **5** (2), 111 –122.

Devendra, C., 2001. Small ruminants: Imperatives for productivity enhancement improved livelihoods and rural growth. A review. *Asian-Australian Journal Animal Science* **10** 1483-1496.

Devendra, C., 2002. Crop – Animal systems in Asia: future perspectives. *Agricultural Systems* **71**, 17 – 25.

Dovie, D.B.K.,Shackleton C.M.,Witkowski E.T.F., 2006.Valuation of communal area livestock benefits, rural livelihoods and related policy issues, *Land Use Policy* 23 pp.260-271.

Dubeuf, J.P., Morand –Fehr, P., Rubin, R., 2004. Situation changes and future of goat industry around the world. *Small Ruminants Research* **51**, 165-173.

Dzimba, J., Matooane, M., 2005. The impact of stock theft in Lesotho. In (Ed) Muloongo, K., Kibasomba, R., Kariri, J.N. The Many Faces of Human Security. Case studies of

Seven Countries in Seven Countries in Southern Africa. Institute for Security Studies, Pretoria.

Ellery, W.N., Scholes, R.J., Scholes, M.C., 1995. The distribution of sweet-veld in South Africa's grassland biome in relation to environmental factors. *African Journal of Range and Forage Science* **12**, 38-45

Ferrington, John. Organisational Rules in farmer participatory research and extension: Lesson from the last decade. Manage – ODI Natural Resources Perspectives no. 27. January 1998.

Fulkerson, W.J., Jamieson, P.A., 1982. Pattern of cortisol release in sheep following administration of synthetic ACTH or imposition of various stressor agents. *Australian Journal Biological Science* **35**, 215-222.

Gatenby, R.M., 1986. Comparison of Sumatra sheep and three hair sheep crossbreeds II. Reproductive performance of F1 ewes. Sheep production in the tropics and subtropics.

Grandin, B.E., de Leeuw, P.N., de Souza, M., 1991. Labour and Livestock Management. In: Bekure, S., et al. (Ed), An Analysis of the Livestock System of Maasai Pastoralists in Eastern Kajiado District, Kenya. ILCA (International Livestock Centre for Africa), Systems Study. ILCA, Addis Ababa, Ethiopia.

Hargreaves, A.L., Hutson, G.D., 1990. Some effects of repeated handling on stress responses in sheep. *Applied Animal Behaviour Science* **26**, 253-265.

Jephcott, E.H., McMillen, I.C., Rushen, J.P., Thornburn, G.D., 1987. A comparison of the effects of electro immobilisation and/or shearing procedures on ovine plasma concentration of beta- endorphin, beta-lipoprotein and cortisol. *Research Veterinary Science* **43**, 97-100.

Kilgour, R., de Langen, H., 1970. Stress in sheep resulting from management practices. Proc. NZ Soc. *Animal Production* **30**, 65-76.

Kosgey, I.S., Rowlands, G.J., van Arendonk, J.A.M., Baker., R.L., 2008. Small ruminant production in smallholder and pastoral/extensive farming systems in Kenya. *Small Ruminants Research* **77,** 11-24

Kosgey, I.S., Okeyo.A.M., 2007. Genetic improvements of small ruminants in low-import, smallholder production systems: Technical and infrastructural issues. In: Notter, D.R.,Barker, R.L.,Cockett, N. (Eds.),The outlook for Quantitative and Molecular Genetic Applications in Improving Sheep and Goats. *Small Ruminants Research* **70**, 76-88.

Kunene, N. W., Fossey A. 2006. A survey on livestock production in some traditional areas Northern Kwazulu Natal in South Africa. *Livestock Research for Rural Development* **18** (8).

Kynock, G., Ulicki, T., 2001. Cross-border raiding and community conflict in the Lesotho-South African border zone. Southern African Migration Project (SAMP), Migration Policy Series No.21.

Lebbie, S.H.B., Mastapha, P.R., 1985. Goat production in the Swaziland Middleveld. In R.T. Wilson and D. Bourzat (ed) Small Ruminants in Africa agriculture. Proceedings of a conference held at ILCA, Addis Ababa, Ethiopia, 30 September – 4 October 1985, ILCA, Addis Ababa, Ethiopia. pp. 225-234.

Lesoli, M.S., 2008. Vegetation, soil status, human perceptions on the condition of communal rangelands of the Eastern Cape, South Africa. M.Sc., Thesis,University of Fort Hare, Alice, South Africa.

Mahanjana A.M., Cronje, P.B., 2000. Factors affecting sheep production in a communal farming system in Eastern Cape region of South Africa, South Africa. *Journal of Animal Science* **30,** 149-154.

Marufu, M.C., Chimonyo, M., Dzama, K., Mapiye, C., 2010. Seroprevalence of tick-borne diseases in communal cattle reared on sweet and sour rangelands in semi-arid area of South Africa. *The Veterinary Journal* **184**, 71-76.

Mashatise, E., Hamudikuwanda, H., Dzama, K., Chimonyo, M., Kanengoni, A., 2005. Socio-economic roles, traditional management systems and reproductive patterns of Mukota pigs in semi-arid north-eastern Zimbabwe. *Bunda Journal of Agriculture, Environmental Science and Technology* **3,** 97-105.

Molony, V., Kent, J.E., McKendrick, I.J., 2002. Validation of a method for assessment of an acute pain in lambs. *Applied Animal Behaviour Science* **76**, 215-238.

Morand –Fehr, P., Boyazoglu, J., 1999. Present state and future outlook of the small ruminant sector. *Small Ruminant Research* **34**, 175-188.

Muchenje, V., Dzama K., Chimonyo, M., Strydom, P. E., Raats, J.G., 2008. Tick Susceptibility and its effects on growth performance and carcass characteristics of Nguni, Bonsmara and Angus steers raised on natural pasture. *Animal* **2**, 298 – 304.

Nqeno, N., Chimonyo, M., Mapiye, C., Marufu, M.C., 2009. Ovarian activity, conception and pregnancy patterns of cows in the semi-arid and communal rangelands in the Eastern Cape Province of South Africa. *Animal Reproduction Science* **118**, 140–147

Perret, S., Carstens, J., Randela, R., Moyo, S., 2000. Activity systems and livelihoods in the Eastern Cape rural areas (Transkei). University of Pretoris/CIRAD Wort Paper 2000/2 CIRAD TERA num 28/00, 35p.

Philipsson, J., Rege, J. E. O., Okeyo, A. M., 2006. Sustainable breeding for tropical farming systems. In:Ojango, J.M., Malmfors, B. and Okeyo, A.M., (eds), Animal Genetics

Training Resource, version 2, International Livestock Research Institute, Nairobi, Kenya and Swedish University of Agricultural Sciences, Uppsala, Sweden.

Rodriguez, A., Ali, I., Afzal, M., Shah, N.A., Mustafa, U., 1995. Price expectations of sheep and goats by producers and intermediaries in Quetta market, Pakistan. *Agricultural Economics* **12,** 79-90.

Rushen, J., 1996. Using aversion learning techniques to assess the mental state, suffering and welfare of farm animals. *Journal Animal Science* **74**, 1990 – 1995.

Statistical Analysis Systems, 2007. Statistical analysis system user's guide (5th Edition), Version 6, (SAS Institute Inc., Raleigh, North Carolina, USA).

Shackleton C.M., 1995. The Direct Use Value of Goods and Services Attributed to cattle and Goats in the Sand River Catchments, Bushbuckridge, CSIR- Environment Report No ENV-P-C 99003, CSIR, Pretoria.

Simela, L., Montshwe, B.D., Mahanjana, A.M., Tshuwa, M.P., 2006. The Livestock Production environment in the South Africa Small holder sector, new challenge for the animal science industry science industries. *South African Society of Animal Science*. 41st Congress Abstracts. pp. 66.

Slingerlands, M., 2000. Mixed farming: scope of constraints in West African Savanna. PhD Thesis. Wageningan University, the Netherlands. 289pp.

Starkey, P., 1996. Animal Power in South Africa: a summary of some key issues. Technology Centre for Agriculture and Rural Cooperation. Harare. Pp 8-12.

Stephenson, T., H,Budge., A,Mostyn., S,Pearce., R,Webb., M.E,Symonds., 2001. Fetal and neonatal adipose maturation: A primary site of cytokine and cytokine-receptor action. *Biochemistry Society Transaction* **29,** 80-85.

Tambi, E.N., Fomunyam, R.T., 1985. Survey of sheep and goat production marketing systems. By-products Cameroon progress report, 1985-86.

Tibbo, M., 2006. Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopian highlands. PhD Thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Verbeek, E., Kanis, E., Bett, R.C., Kosgey, I.S., 2007. Socio-economic actors influencing small ruminant breeding in Kenya. Livestock Research for Rural Development. Volume 19 Article #6 Retrieved September 4, 2009, from http://www.cipav.org.co/lrrd/lrrd19/6/verb19077.htm.

CHAPTER 4: Flock dynamics, body condition and weight variation of sheep in two ecologically different resource-poor communal farming systems of the Eastern Cape.

Abstract

The objective of the study was to determine the flock dynamics of sheep in two ecologically different communal areas of Eastern Cape Province of South Africa. A longitudinal survey was carried out. Farmers were randomly selected and a questionnaire was administered from July 2009 to June, 2010. Twenty-one farmers in Gaga and fifteen farmers in Sompondo were monitored for 12. These two ecologically different communal areas have different topography, soil types, soil fertility and agro-climatic conditions. Each flock was assessed for entries, exits, body condition and weight. At the beginning of the experiment the mean ram to ewe ratios were 1: 7 and 1: 10 for Gaga and Sompondo respectively. Total entrances for each flock were higher ($p < 0.05$) in hot-dry season and hot-wet season than in other seasons. Most of the lambs were born in hot-dry season (September) and cool-dry season (June) for larger flocks (10.90±3.02) and for small flocks (3.65±3.02), respectively. High lamb mortalities were experienced in the post-rainy (April) and hot-wet (December) seasons. Foot- rot, gall sickness and heart water were the main causes of death of ewes across the two villages. Thefts, road accidents and predation were also reported for both lambs and adults in the two villages. Village had significant effect on sheep production potential ($p<0.05$) in both flock classes. The average sheep production potential for Gaga and Sompondo was 0.78 ± 0.006 and 0.72 ± 0.009 respectively. For Gaga and Sompondo the average sheep production efficiency (SPE) values were 0.50 ± 0.116 and 0.50 ± 0.096, respectively. The SPE was highly affected ($p < 0.05$) by season and flock size. Large flock had a higher SPE values and the SPE ranged from 1.11 ± 0.193 in April, a post-rainy season month to 1.55 ± 0.193 in December, a hot-wet season month. However off- take and SPE

was low in the two villages due to high mortality and multifunctionality of sheep. Total outflow were mainly lamb mortalities and occurred in the hot-wet (December), hot-dry (September) and post-rainy (April) seasons. To estimate sheep flock demographics in the two ecologically different communal areas, intervention strategies to improve on lamb mortalities need to be developed.

Key words: exits, entrances, sheep production potential, sheep production efficiency, body condition score, body weight

4.1 Introduction

Improvement of sheep productivity offers opportunities for most resource-poor farmers to earn better returns in terms of cash and improved nutritional status. Driving forces for changes in sheep production systems operate at different aggregation levels due to agro-ecological conditions and have got impact on availability of feed and prevalence of diseases/parasites. However, inadequate description, importance, classification and extent of the contribution of communal sheep at household and community level are poorly understood resulting in poor understanding of the potential of most sheep breeds (Kosgey *et. al.,* 2006; Tixier – Boichard *et. al.,* 2008). This indicates the need to develop measures that can be used to quantify sheep. In this regard, indices such as production potential and production efficiency have been developed (Muchadeyi *et al.,* 2005; Chiduwa *et al.,* 2008). Production potential of sheep is the proportion of mature and growing sheep to the total flock size and is important in the computation of production efficiency. Production efficiency is a variable that reflects the proportion of potentially saleable animals sold and /or slaughtered by farmers. Determination of efficiency of sheep production systems is crucial in generating intervention strategies to improve sheep productivity. Production potential and production efficiency have been implemented in the description of communal chickens (Muchadeyi *et al.,* 2005), pigs (Chiduwa *et al.,* 2008), cattle (Mapiye *et al.,* 2008) and goats (Rumosa Gwaze *et al.,* 2009). However SPE monitors the mature sheep sold or slaughtered but neglects the multifunction of sheep. It also fails to capture other production outputs of smallholder sheep production like wool production and manure production.

Research has been conducted on dynamics of goats in communal areas (Rumosa Gwaze *et al.*, 2009), cattle (Mapiye *et al.*, 2009), chicken (Muchadeyi *et al.*, 2005), pigs (Chiduwa *et al.*, 2008) but did not include quality aspects (weights and body condition score) in their

studies. They also ignored the aspect of ecologically different regions, yet ecologically differences are likely to affect dynamics. Agro-ecological zones have a characteristic interrelationship between farming systems and various environmental features not just climate (White *et al*., 2001). Each zone is generally based on altitude, lowland zone and upland zone.

Although surveys, such as the one in Chapter 3 are important, they are once- off experiments and the information generated might not be accurate therefore some long term studies are necessary. Monitoring of sheep flock dynamics is a crucial exercise that needs to be continuously carried out so as to identify major constraints in sheep production, with the active participation of farmers. Information on the effect of seasonal changes (Ellery *et. al.*, 1995) on flock dynamics and management in communal areas is scarce, making it difficult to assess the efficiency contribution of communal sheep growers to the economies of countries such as South Africa. Lack of information also makes it difficult to predict sheep sales and consumption patterns in the communal areas. Generation of information on productivity of sheep over seasons can be captured through close monitoring of changes in flock sizes and productivity. Flock monitoring involves the participation of willing farmers (Rumosa Gwaze *et al*., 2009) and takes advantage of indigenous resources and knowledge whilst at the same time introducing new technologies.

Monitoring of flocks for at least a year is adequate to cover all seasons and to provide sufficient data for development of appropriate intervention strategies. Aspects that should be monitored include determination of the effects of season, village, flock size, on births, purchases, exchanges, sales, deaths, off-take, sheep production potential (SPP), sheep production efficiency (SPE) and effect of sex, age, village, season on body weights (BW)

and body condition score (BCS) .The objective of the study was to determine flock dynamics of sheep in the two ecologically different communal areas. The null hypothesis tested was that there is no difference in the flock dynamics of sheep in the two ecologically different areas.

4.2 Materials and Methods

4.2.1 Study sites

The study was conducted in Gaga and Sompondo Villages in the Amathole District Municipality of the Eastern Cape Province. Details on the description of the sites are described in Section 3.2.1.

4.2.2 Sampling of households and experimental animals

Selection of the households was based on the basis of a farmer owning at least ten mature sheep, willingness to participate in the study and presence of a literate member in the household. In this research, literacy was defined as the ability to record sheep entrance and exits in the record booklets provided. Selection of farmers was done with the assistance of chairpersons of Sheep Growers Association of the two villages and agricultural extension officers. Twenty-one and fifteen households were selected from Gaga and Sompondo, respectively.

Animals used in this study were sheep of non descriptive breeds. Each household provided three ewes and three lambs of either sex. The selected sheep were ear tagged for identification. The experimental animals were weighed, body condition scored monthly from July 2009 to June 2010 using a scale (Ruddscale, Durbanville, South Africa). Sheep were body condition scored on a scale of 1-5, with a score of 1 indicating a thin and

emaciated sheep whilst a condition of 5 indicated an obese sheep (Friedricks, 1993) after visual appraisal and palpation on the lumbar and sternum areas.

4.2.3 Monitoring flock sizes, body condition and weights

Flock dynamics data were recorded per households by trained research assistants. Flocks were classified into large and small flocks. Flocks with up to 30 adult sheep were considered small and those with more than thirty were considered large flock. The sheep flock was classified into four categories (lambs, both male and female, female adults, both gimmers and mature ewes, rams, both young and mature rams, castrates, both wethers and mature castrates). Farmers were also categorised into two; with those less than 40 years as young and those more than 40 years as old. Table 4.1 shows the distribution of sheep classes in Gaga and Sompondo. The various sheep classes and the total number of sheep at the beginning of the study in the two villages are shown in Table 4.2.

4.2.4 Sheep off- take, sheep production potential and sheep production efficiency

Off-take was calculated as the total number of sheep that were sold and/or slaughtered plus those gifted out permanently as a proportion of the flock size every month (Wilson, 1986). Sheep production potential (SPP) and sheep production efficiency (SPE) for each willing household flock was calculated as described by Amanor (1995) and Chiduwa *et al.* (2008).

Table 4. 1: Distribution of participating farmers per village at the beginning of the trial

	Village			
	Sompondo		Gaga	
Characteristic	**Large flocks**	**Small flocks**	**Large flocks**	**Small flocks**
Gender of farmer				
Male	2	10	3	9
Female	2	1	3	6
Age of farmer				
≤ 40	0	0	0	4
> 40	4	11	6	11

Table 4. 2: Average flock structure in Gaga and Sompondo villages at the beginning of the trial

	Flock structure				
Village	**Lambs**	**Female adults**	**rams**	**Castrates**	**Flock size**
Sompondo					
Large flock	17	49	2	16	84
Small flock	29	69	8	9	115
Gaga					
Large flock	52	108	5	15	180
Small flock	10	22	1	7	40

At the commencement of the trial each farmer was issued with a booklet and trained on how to record all entrances and exits that occurred in their sheep flocks. The entrance recorded were births and purchases whilst exits comprised of sales, slaughter, mortality, thefts and missing sheep. Sheep entrusted, gifts and exchanges were recorded as entrances or exits depending on whether the sheep involved were exiting or joining the flock.

The SPP was computed as the proportion of mature and growing sheep to the total flock size. It was calculated as:

$$SPP = \frac{N}{F}$$; where

SPP = sheep production potential;

N = number of mature sheep and growing sheep; and

F = flock size.

The SPE was defined as the proportion of mature sheep sold and/or consumed as a proportion of SPP, and calculated as:

$$SPE = \left(\frac{M}{SPP} \right) 100$$; where

SPE = sheep production efficiency;

M = number of mature sheep consumed or sold; and

SPP = sheep production potential.

4.2.5 Statistical analyses

The effects of season, village, gender and age of head of household and flock size on entries, exits, SPP, SPE and off-take were determined using the GLM procedure of SAS (2007). The statistical model used was:

Yijklmn= μ + Mí + Vj + Sk + Aι + Fm + (M x V) íj + (M x F) ím + Eíjklmn

Where,

Yijklmn= response variable (SPE, SPP, off – take, lamb mortality, adult mortality, sales, slaughter, sheep entrusted out, births, purchases, exchanges, sheep entrusted in, gifts and number of sheep missing).

μ = constant mean common to all observation;

Mí = effect of month (i = July 2009-June 2010).

Vj = effect of village (j = Sompondo, Gaga);

Sk = effect of gender of farmer (k= male, female);

A_l = effect of age group (l = ≤ 40, > 40);

F_m = effect of flock size (m = small flocks, large flocks);

$(M \times V)_{íj}$ = season x village interaction;

$(M \times F)_{ím}$ = season x flock size interaction and

E_{ijkmn} = random residual error, assumed to be normally distributed.

The effects of season, village, flock size, gender and age of head on proportion of lambs to ewes were determined using the GLM procedure of SAS (2007). The effect of month, village and age of sheep on body condition score and body weight was analysed using GLM procedure of SAS (2007). To stabilise variance the body condition scores were square root transformed. Since the adult sheep were all females so the effect of sex was only tested on lambs. PROC CORR (2007) was used to determine the correlations between body weights and body condition score and total inflows and inflow rams.

4.3 Results

4.3.1 Flock structure and size

Sheep numbers per household in Gaga and Sompondo varied with month in both the small and large flocks as depicted in Figure 4.1. The months of October, November and June were the peak periods for both large and small flock but remained constant in other months of the study periods for small flock. The highest peak period was recorded in June for Gaga (7.08 ± 0.821) and in May for Sompondo (7.92 ± 1.062) in small flock respectively. In Gaga village, the highest peak period for large flock was recorded in the June (25.5 ± 5.85) and in Sompondo, the highest peak was recorded in April (18.0 ± 5.13). There was a general drop in sheep numbers in the large flock between December and February but remained constant for the other months. Rams to ewes' ratios for the two villages were 1:20, 1:19 for Gaga and Sompondo, respectively.

4.3.2 Factors affecting sheep inflows at household level

Village had no effect ($p > 0.05$) on the number of sheep that were entrusted and gifted in (Table 4.3). In addition, there was no variation in terms of sheep slaughtered or missing, due to village. Sheep given out as exchange and offtake were similar in both villages. Total inflows for both flocks in the two villages were significantly affected by month as indicated in Figure 4.2. The pattern of births was identical for both villages in each flock size. Higher inflows ($p < 0.05$) for both small flock and large flock were experienced in June in Gaga and Sompondo respectively.

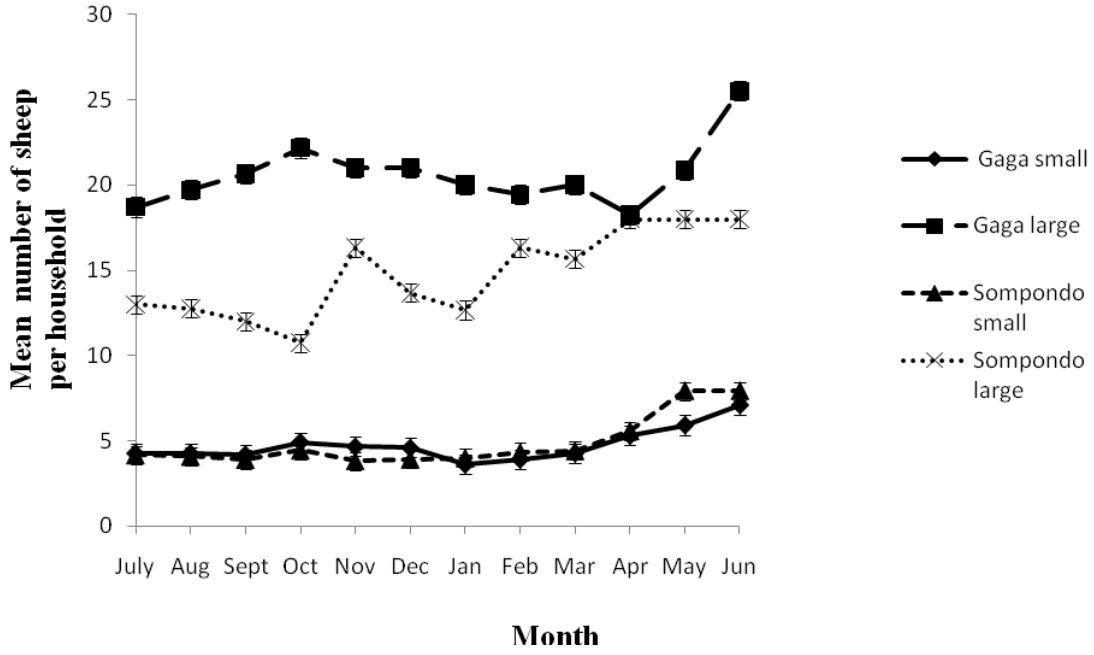

Figure 4. 1: Monthly flock dynamics from July 2009 to June 2010 in the small and large flock groups across the two villages

Table 4. 3: Effect of village on SPP, SPE, off-take, entries and exits in sheep flocks in Gaga and Sompondo

	Village		
Characteristic	**Gaga**	**Sompondo**	**Sig**
Entries			
Births	0.83 ± 0.142	0.49 ± 0.106	*
Purchases	0.22 ± 0.076	0.16 ± 0.072	*
Sheep received as gifts	0.03 ± 0.022	0.01 ± 0.008	ns
Sheep received as exchange	0.01 ± 0.006	0.02 ± 0.016	ns
Sheep entrusted in	0.03 ± 0.014	0.02 ± 0.013	ns
Exits			
Sales	0.06±0.030	0.01±0.009	*
Slaughters	0.08±0.036	0.09±0.054	ns
Missing	0.01±0.017	0.01±0.007	ns
Deaths	0.15±0.072	0.22±0.082	*
Sheep given out as exchange	0.01±0.008	0.01±0.011	ns
Sheep entrusted out	0.00±0.002	0.04±0.018	*
SPP[1]	0.78±0.006	0.72±0.009	*
SPE[2]	4653.96±934.32	4233.59±683.91	*
Off – Take	0.14±0.065	0.13±0.063	ns

*Significance at ($p<0.05$)
[1]Sheep production potential
[2]Sheep production efficiency

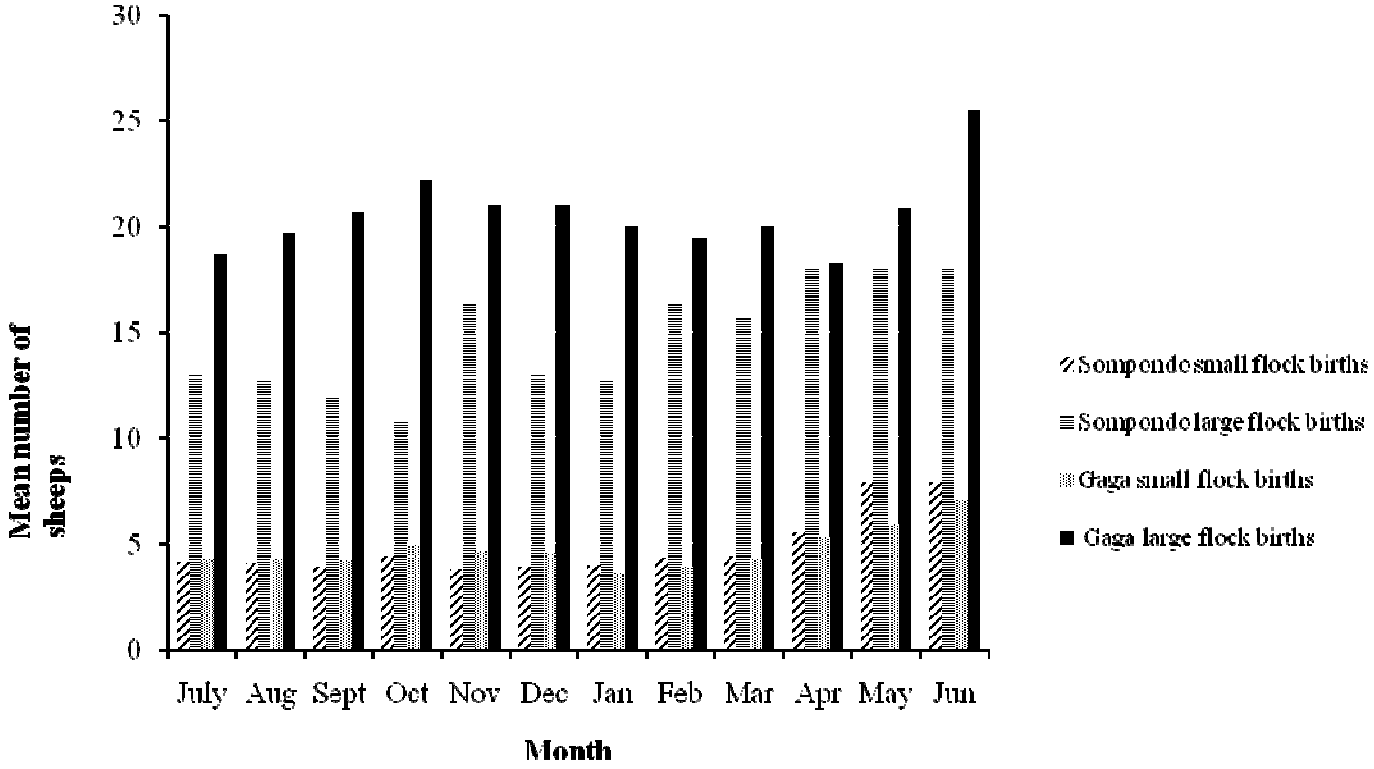

Figure 4. 2: Mean monthly births entries for large and small flocks in Sompondo and Gaga.

There was a significant negative correlation between total inflow and inflow rams, suggesting that the variable inflow rams has an effect on total inflow. As the number of the rams increased the total number of inflows decreased by 7. Month had a significant effect ($P < 0.05$) on proportion of lambs to ewes as indicated in Table 4.4. Higher proportions of lambs to ewes were recorded in April, May and June.

4.3.3 Factors affecting sheep outflow

Lamb mortality was significantly affected by month as indicated in Figure 4.3. In Gaga the highest lamb mortalities were experienced in May (38.09 ± 6.765) followed by November (23.00 ± 6.367). High peak mortality period on lambs in Sompondo was experienced in November (13.33 ± 2.570) and September (13.33 ± 2.570). In Gaga the highest adult mortalities were recorded in December (76.18 ± 15.164) followed October (47.61 ± 7.744) respectively. Adult mortality in Sompondo was at its peak period during the May (20.0 ± 5.567) followed by January (13.33 ± 2.570). Total outflows were mainly through mortality (18.29%), followed by slaughter (8.80%) sales (4.17%), entrusted out (1.62%), missing (1.16%) stolen (1.16%) and others like given out as exchange (0.93%. Sheep mortalities cause very high losses, especially among lambs and

Table 4. 4: Least square means (± standard errors) of proportion of lambs to ewes in sheep flocks in the Eastern Cape villages

Month	Proportion of lambs to ewes
July,2009	0.56
August	0.56
September	0.58
October	0.68
November	0.63
December	0.63
January,2010	0.61
February	0.62
March	0.64
April	0.74
May	0.85
June	0.94
Standard Error	0.06

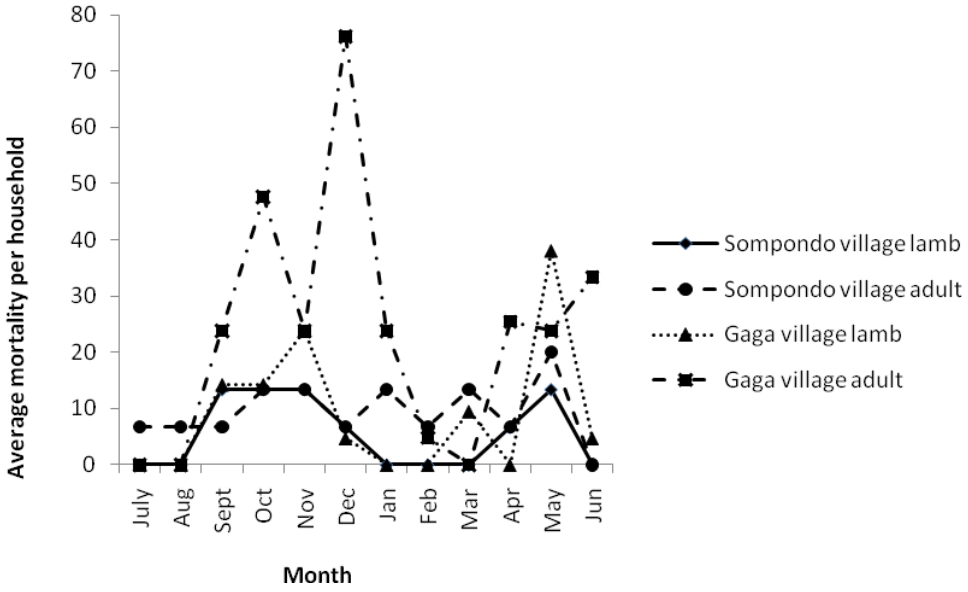

Figure 4. 3: Monthly lamb and adult mortality for the two villages

lactating females, and that more preventive measures are necessary to preserve sheep for use values and scale.

Sales of other classes of sheep like lambs were not affected by gender, age and village. Sale of castrates was significantly affected ($P < 0.05$) by month. Interaction between month and flock size on sale of castrates was significant. The mean sales of castrates per household for the two villages are shown in Figure 4.4. The highest number of castrates' sales in the small flock category across the two villages was recorded in the December followed by April. In Gaga the peak period for sale of castrates in large flock occurred in December. Another rise in castrates' sales was also witnessed in June in the large flock category in Gaga village. Sompondo farmers in the large flock category did not sell any of their castrates during the study period. Most sales in Gaga village in small flocks were registered in April, May and the highest peak period was experienced in the December and January. April and May recorded higher sales in Sompondo village in the small flock category. December had the highest peak sales in Sompondo in the small flock class (Figure 4.5).

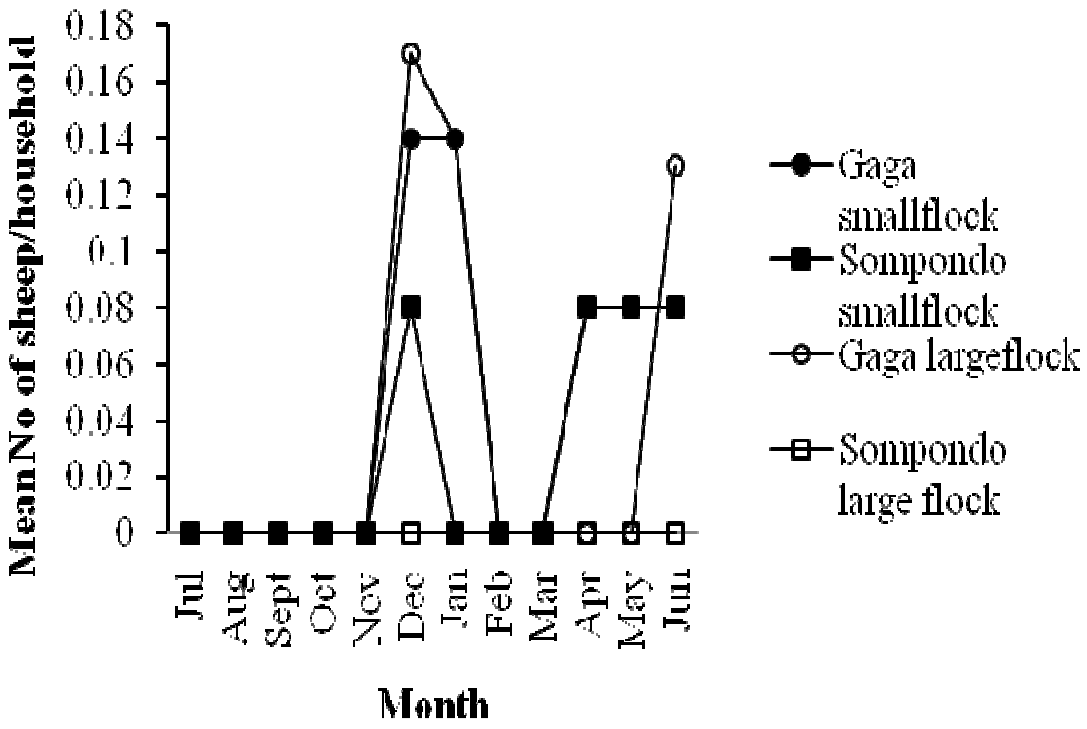

Figure 4. 4: Monthly sales of castrates in the small and large flocks for Gaga and Sompondo villages in Eastern Cape

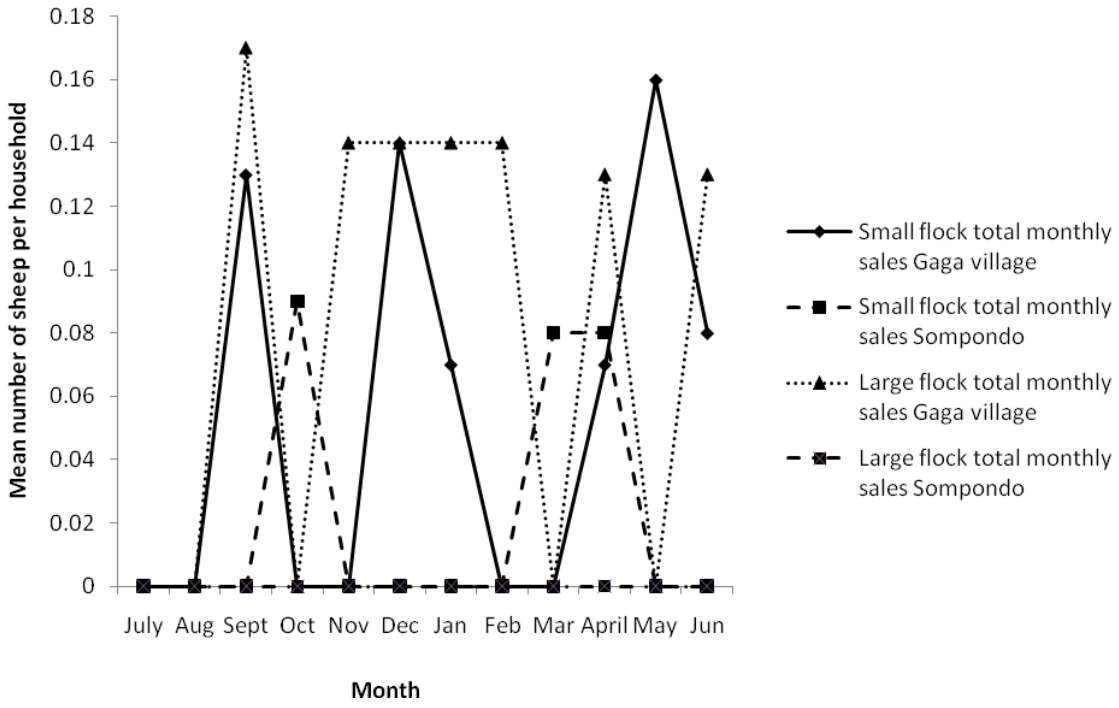

Figure 4. 5: Monthly total sales of sheep in the small and large flocks of Gaga and Sompondo villages in Eastern Cape

4.3.4 Effect of month on sheep production potential, sheep production efficiency and offtake.

Month significantly ($P < 0.05$) affected SPP. Higher ($P < 0.05$) SPP was recorded in September, January and March in Gaga village (Fig. 4.6). In Sompondo the highest peak period for SPP was observed in September followed by the November. Sheep production efficiency was significantly affected by month and village as depicted in Figure 4.7. June was the peak month for SPE in Gaga village (6289.67±1324.814). The peak periods for Sompondo were experienced in April, May, June and November. The highest peak was recorded in the June (4596.61 ± 754.656). October had a significant ($P < 0.05$) number of growers of mature sheep consumed, followed by August, March then April across the two villages respectively. Consumption dropped from mid April to June months respectively.

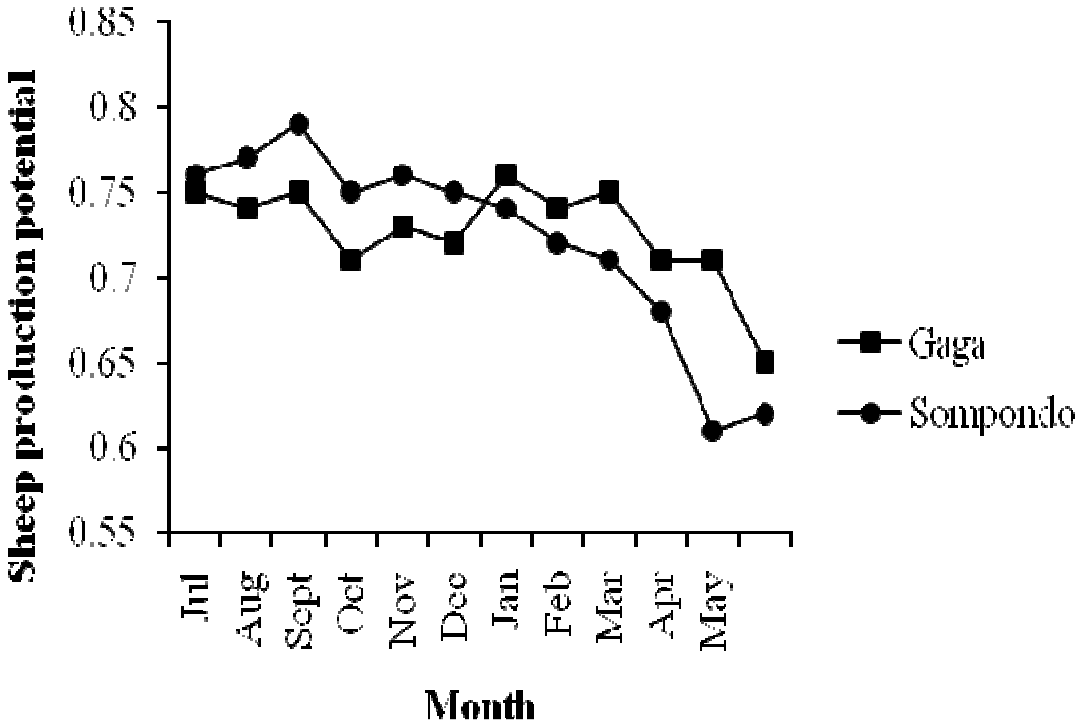

Figure 4. 6: Effect of month on sheep production potential for sheep flocks in Gaga and Sompondo villages

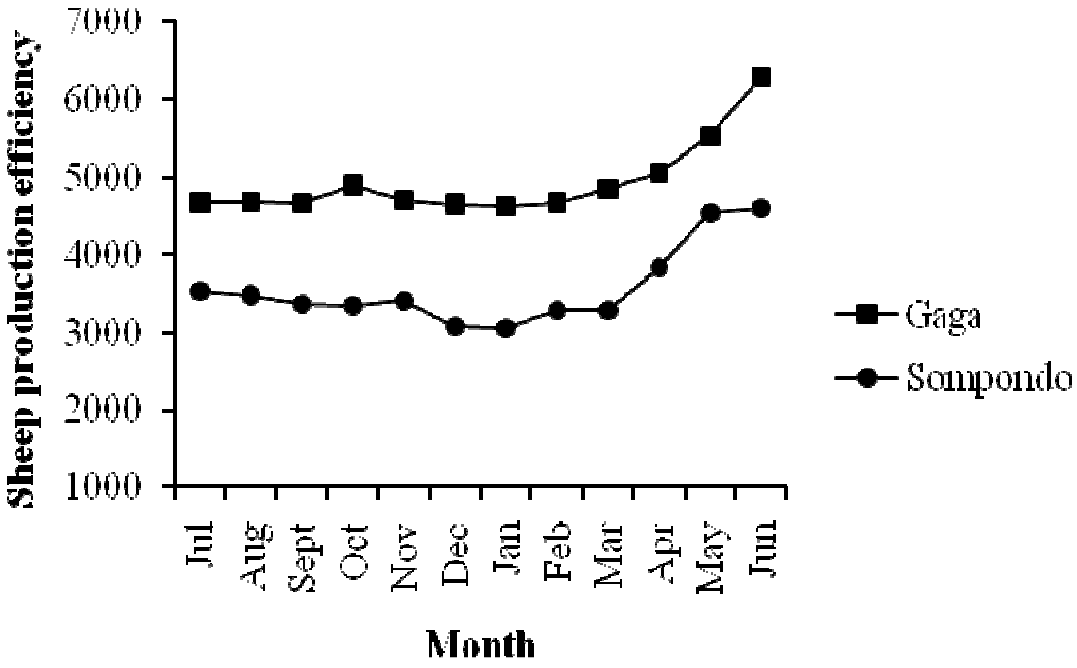

Figure 4. 7: Effect of month on sheep production efficiency for sheep flocks in the Gaga and Sompondo villages

4.4 Effect of month on body condition scores and body weight

The highest ($p < 0.05$) body weights were recorded in the post- rainy season and cool-dry season in both lambs and ewes as indicated in Figure 4.8. Ewes in Gaga had better weights than those in Sompondo. Ewes in Gaga registered a relatively higher weight gains (41.99 ± 0.482) in the post-rainy season whereas in Sompondo it was realised in the cool-dry season (37.04 ± 0.581). Like ewes in Sompondo, ewes in Gaga maintained the same weight gained in the post-rainy season. In Gaga, male lambs had higher weights than females. They registered a peak weight gain in the post-rainy season (29.43 ± 0.788). Male lambs in Sompondo had higher weights compared to their female counterpart. The highest peak (26.59 ± 1.183) was registered in the post-rainy season. Female lambs in Gaga registered a peak weight gain (28.10 ± 0.688) in the cool-dry season. Female lambs in Gaga maintained their body weights from summer to autumn. Lambs maintained their weights from summer (23.04 ± 0.557), autumn (28.10 ± 0.688) and winter (22.10 ± 0.691) and weight reductions were experienced in spring (14.36 ± 0.732) The age of the adult sheep was positively ($p < 0.05$) correlated with weight and body condition score as shown in Table 4.5.

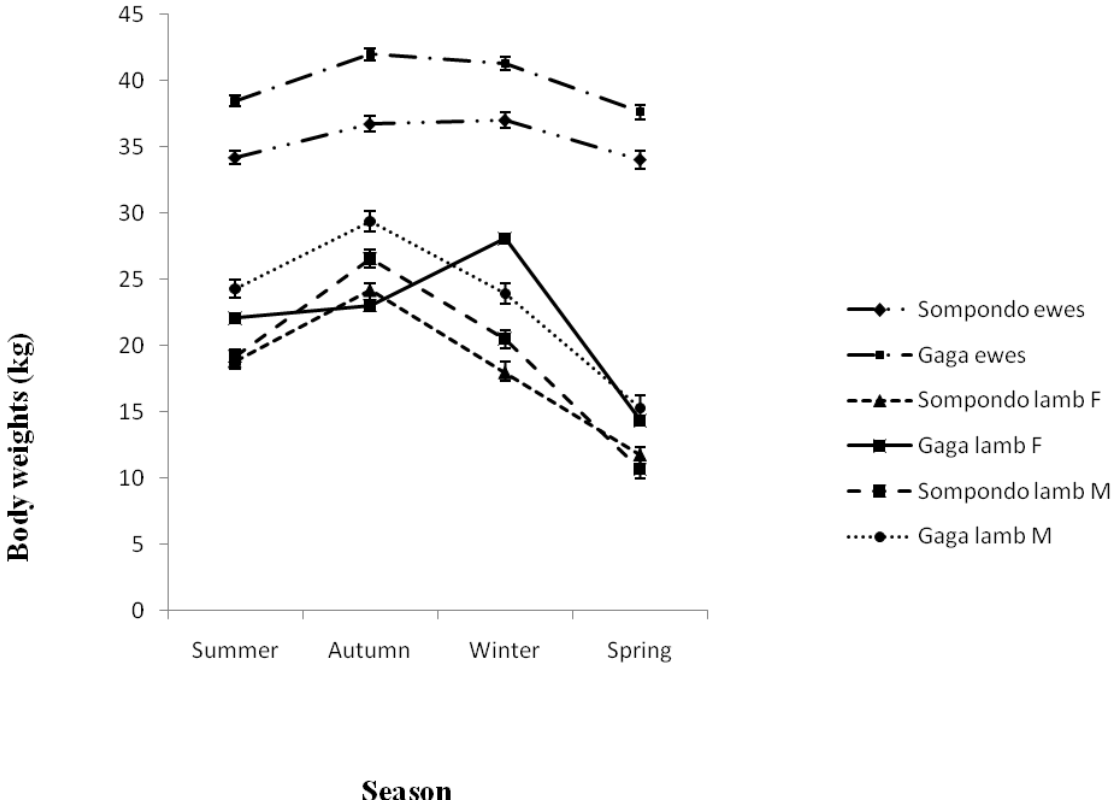

Figure 4. 8: Seasonal changes of body weight in adult sheep and young sheep in Gaga and Sompondo villages

Table 4. 5: Correlations among age class of adult sheep, body condition score and weight (n=2257) in Gaga and Sompondo villages

	Age	BCS	weight
Age	-		
BCS[1]	0.42778*	-	
Weight	0.71858*	0.77181*	-

Values with an asterisk indicates significance at P<0.01 for *.

[1] Body condition score

There was a significant interaction of village and season on body condition scores of the study animals (Figure 4.9). Sheep in Gaga had higher ($p > 0.05$) body condition scores than those in Sompondo in the post-rainy and cool-dry seasons. Gaga, a lowland area, had higher sheep bodyweights and better body condition scores compared to those in Sompondo, a highland area during hot-dry season. Across the two villages, during the hot-wet season, body weights and body condition scores were almost the same. Sheep in Gaga realised a peak in BCSs in the post-rainy season (4.01 ± 0.029) whereas sheep in Sompondo realised a peak in BCSs in the cool-dry season (3.63 ± 0.036) which was however below that was recorded by sheep in Gaga during the same season. Sex had a significant effect ($p < 0.05$) on weight gain of lambs.

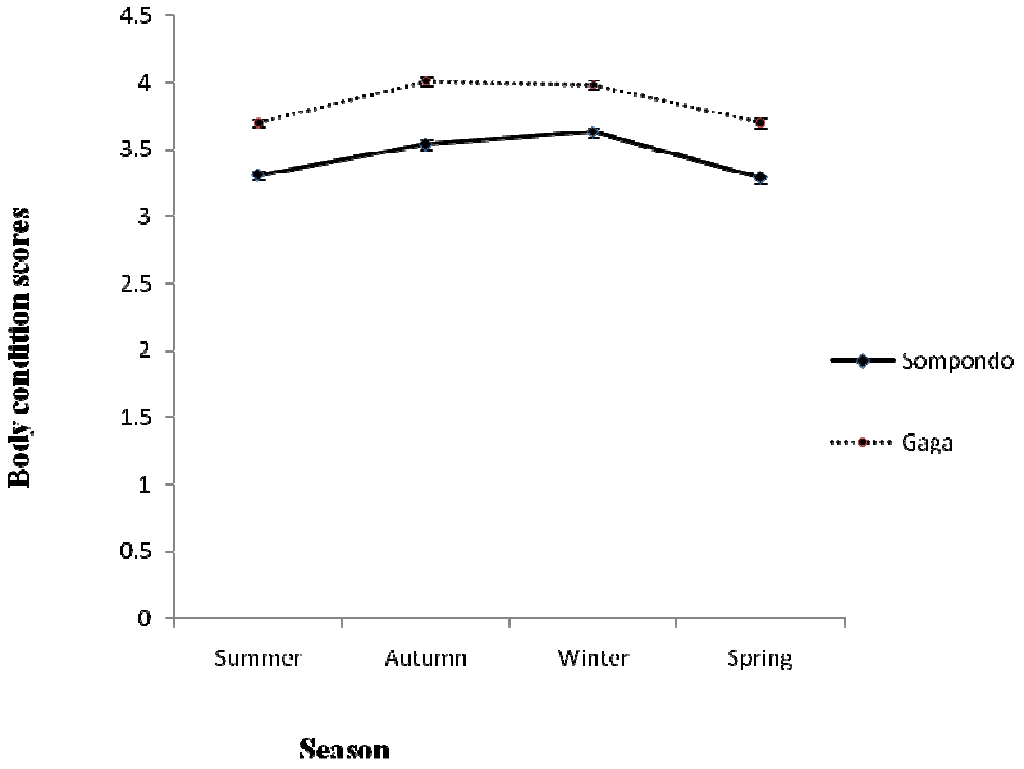

Figure 4. 9: Effects of season on body condition score of sheep in the highland and lowland rangeland areas Gaga and Sompondo villages

4.5 Discussion

Sheep population is a consequence of the interplay of births, deaths, purchases, sales, exchanges and consumption. Agro-ecological zones have a characteristic interrelationship between farming systems and various environmental features not just climate (White *et al.*, 2001). Each zone has a different topography, soil types, soil fertility and agro-climatic conditions. In South Africa, information on the contribution of sheep to household economy is very scarce. Estimation of contribution of sheep to the livelihood of resource poor farmers (Anderson, 2003) can be achieved through monitoring of flock dynamics over time. It was observed in this study that most of the sheep, both in small and large flock categories in Gaga (lowland) and Sompondo (highland) were owned by males.

The finding that flock inflows were affected by month can be attributed to the fact that during hot-wet months and cool dry months forage quantity and quality are high (Peacock *et al.*, 2005) and coincide with the periods of increased parturitions in the two villages. Abundance of high quality forages during these months can increase chances of survival of lambs. Feed availability declines from the post-rainy season onwards as temperature and rainfall drop, reaching a low point, during the cool-dry season when plant materials are dormant, then rise with emergence of new shoots in the hot-dry season, and establishment of plants following rains in the hot-wet season. Seasonal trend in rainfall and feed availability had an influence on the number of sheep by affecting mortality rates. This finding concurs with observations by Scoones (1995), Fynn and O'Connor (2000) and Mellink and Martin (2001) who reported a curvi-linear relationship between rainfall, feed supply and cattle performance in the arid and semi-arid areas.

The high mortality observed as the highest contributor to the total sheep outflows were related to their greater vulnerability to seasonal feeds. The fact that mortality constituted the greatest contributor to outflows is in agreement with findings by Reddy and Choudhuri (2000). Mortality was higher during the hot-dry and hot-wet season due to seasonal changes in the quality and availability of feed resources. Differences in mortalities in Sompondo and Gaga could be a variation in agro-ecological characteristics of the two areas. Sompondo is a sour rangeland which is mainly composed of annual grass species, which lose nutritive value and palatability during the dry season whereas Gaga is a sweet rangeland comprised of perennial grasses that remain nutritious and palatable all year round (Ellery *et al*., 1995). The finding that seasonal patterns have influence on the quality and feed resources availability is in agreement with findings observed by Narwade *et al.* (1999) in a similar study. The high mortality observed in the hot-wet season can be attributed to warm and moist conditions which promote vector survival and multiplication (Marufu *et al*., 2010). For example, gall-sickness and heartwater diseases which were reported as the main cause of sheep mortality in this study are transmitted by ticks whose rate of proliferation is accelerated when environmental temperatures and humidity are high (Marufu *et al*., 2010; Muchenje *et al*., 2008a).

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

take in the two ecologically difference communal areas .Alternatively, farmers concentrate on selling their sheep at the end of the post-rainy season when they are still in good condition.

The highest proportion of sheep lost to mortality originated in those households with small flocks in both villages and these are the same farmers whose kraals were not protected. During feed-back time, farmers argued that resource-poor farmers cannot easily get information and inputs and thus less capable of preventing sheep mortalities. This is a strong argument to support interventions to reduce sheep mortality (Reddy and Choudhuri, 2000), as this would increase the number of animals available for sale and use for those who depend greatly on the economic potential of sheep.

In this study, observed lamb mortality rates in Sompondo and Gaga were higher than the less than five percent rates acceptable under commercial enterprises (Kyriazakis and Whittemore, 2006). The observation that lamb mortality was the major exits from both flock sizes in the two villages was expected. Conditions under communal areas where sheep housing facilities are poor or non-existent, expose lambs to vagaries of weather. Lambs are likely to die from rain, cold weather and predation. In the two ecologically difference villages, although these causes were not quantified accurately, the finding that lamb mortality was higher during the rainy season than during the cold and hot seasons in the two villages, indicates that rain, rather than cold weather was the major constraint to lamb survival as observed elsewhere (Ncube *et al.,* 2003). In the Eastern Cape Province, January is usually the wettest month of the year (Marufu *et al.,* 2010). In this study the observation that the peak contribution of lambs' mortality to total exits in upland and lowland was observed in January confirms the drastic influence of rain on mortality. Similar observation were made by Ncube *et al*. (2003) and Chimonyo and Dzama (2007).

The fact that almost one quarter of the sheep for sale originated from the farmers with small flocks in upland and lowland shows that although they have limited resources these farmers make a significant contribution to the market. They sell to get money for family education, household needs, health, village taxes and emergencies. Farmers with small sheep flocks showed relatively higher castrates' sales and outflow rates in Gaga and Sompondo compared to those with big flocks. They thus produced more sheep and slaughtered and sold more sheep in relation to their flock size. But they also faced relatively high mortality rates in comparison to production rates. This was also reported in a study by Palanivel and Gajendran (2006). The fact that farmers with small sheep flocks had higher production of sheep and mortality, this confirms that high mortality rates severely restrict farmers with small flocks from deriving higher benefits from sheep. A continuous need of cash, to solve immediate problems, these farmers cannot build up their flocks (Rumosa Gwaze *et al*., 2009) to sustainable size and therefore remain with low sheep production. Interventions that aim at increasing the supply of sheep to the market therefore need to target resource-poor farmers. Furthermore, facilitating market to resource-poor farmers increases prices for their sheep and thereby contributes to food security and income growth. However, causes of lamb mortality in this study were not adequately monitored, since farmers in Sompondo and Gaga did not send dead lambs for post-mortem. More to it, veterinary service support for sheep in the communal areas of South Africa is quite weak.

In this study, the observation that large flocks in Sompondo and Gaga had larger SPE can be attributed to the fact that large flocks had more sheep to dispose than small flocks. The farmers with large flocks probably will be trying to reduce their flock numbers to manageable sizes (Rumosa Gwaze *et al.*, 2009). Sheep production efficiency was generally low in upland

and lowland, a sign that farmers are reluctant to sell their sheep. In this study, the production efficiency that was observed in the two villages was not comparable to the production potential obtained. The SPP was not different for the two villages but however the SPE was different for the two villages indicating that a higher number of mature and growing sheep were being sold by farmers at Gaga compared to sheep farmers in Sompondo village. Most of the farmers from Gaga were unemployed and dependent mostly on cash from sell of their sheep. Its nearness to Alice town, a potential market for mutton meat could also be a contributing factor towards a rise of sales in Gaga compared to Sompondo which is located 20km away. In general, therefore it implies that as income become lower, resource-poor livestock producers attempt to offset diseconomies of scale by relying more on their animals (Hary *et al*., 2003). The SPE monitors the mature sheep sold or slaughtered but neglects the multifunction of sheep. It also fails to capture other production outputs of small holder sheep production like wool production, manure production and the gifts out that were noted by Mashatise *et al.* (2005) and Holness *et al*. (2005). It is, therefore, important to come up with SPP and SPE formulae that consider all production outputs and contribution of sheep to the monitoring period. However, there is also a need to monitor growth rates and condition score changes of the sheep to promote the production of good quality mutton products.

Body weights are traditionally used to assess nutritional statues of animals (Chimonyo *et al.,* 2002; Ndlovu *et al*., 2007). In this study, lambs born in Gaga gained higher weights compared to lambs born in Sompondo probably due to perennial grasses that are found in Gaga that remain nutritious and highly palatable throughout the year (Ellery *et al*., 1995). In the sweet rangelands, which is characterised by natural browse with a crude protein content of approximately 20%, there is not much variation interms of protein content of feed with season (Peacock *et al*., 2005). The variation in growth rate among locations concurs with

previous results that compared performance of sheep in different locations (Gatenby *et al.,* 1997; Gautsch 1992, Mukasa-Mugerwa *et al.,* 2000). In this study, lambs born in the wet season were heavier than lambs born in dry and post- rainy season on weight gains and was due to the availability of sufficient grazing in both villages. In upland and lowland areas, male lambs were observed to be heavier than female lambs, grew faster than females. The difference in weight gain between sexes is in agreement with reports in literature (Nawaz and Khalil, 1998; Rastogi, 2001). According to Ebangi *et al.* (1996) the larger gain weight of males in comparison to female lambs could be due to the hormonal difference in their endocrinological and physiological functions.

Body condition scoring is, undoubtedly, the best practical indicator of the nutritional status (Ndlovu *et al*., 2007). Sheep began to lose condition in post-rainy season possibly due to decreasing quality of grazing during flowering in the post-rainy season. High body scores observed in the highland rangeland compared to lowland rangeland could be attributed to their differences in rainfall. Highland receives more precipitation at the end of the cool-dry season every year compared to lowland rangeland (Ellery *et al*., 1995; Tainton, 1999). The high precipitation ensures feed availability in the hot-dry season. Although the ewes had consistently low body condition, it would have been expected that body condition and body weight changes should generally follow the same pattern (Ndlovu *et al.,* 2007). The difference in the patterns could, possibly, reflect the subjective nature of body condition scoring, especially when animals of different conformation are being compared (Muchenje *et al.*, 2008b).

4.6. Conclusion

Mortality was the major contributor to exits from the flock which indicated some inefficiency in the communal area sheep production system. Across the period of study the number of adult sheep was almost constant. Generally the SPP was almost the same in the two villages. However, the SPE was higher in large flocks in both villages. Peak periods were August, October, December and March. The SPE realised the highest peak in December. In April, SPE was almost constant in the two villages. The variability observed in growth performance between lambs located in the two villages suggested that genetic diversity exists which could be exploited for genetic improvements. Study on body weight and body condition changes at different season in the two villages in adult female ewes and lambs revealed that the body weight was lower in summer. Mortality in lambs was higher in the hot-wet season in the two ecologically different communal areas but its cause is unknown hence this calls for a further research to establish causes of lamb mortality.

4.7 References:

Anderson, S., 2003. Animal genetic resources and sustainable livelihoods. *Ecological Economics* **45,** 331-339.

Chiduwa, G., Chimonyo, M., Halimani, T.E., Chisambara, S.R., Dzama, K., 2008. Herd dynamics and contribution of indigenous pigs to the livelihoods of rural farmers in a semi-arid area of Zimbabwe. *Tropical Animal Health and Production* **37,** 333-344.

Chimonyo, M., Dzama, K., 2007. Estimation of genetic parameters for growth performance and carcass traits in Mukota pigs. *Animal* **1**, 313-323.

Coetzee, L., Montshwe, B.D., Jooste, A., 2005. The marketing of Livestock on communal lands in the Eastern Cape Province: constraints, challenges and implications for the extension services. *South African Journal of Agricultural Extension* **34** (1), 81-103.

Delali, B.K., Dovie, D.B.K., Charli, M., Shackleton, C.M., Witkowski, E.T.F., 2006. Valuation of communal area livestock benefits, rural livelihoods and related policy issues. *Land Use Policy* **23**, 260-271.

Ebangi, L., Nwakalor, L.N., Mbah, D.A., Abbah, D., 1996. Factors affecting the birth weight and the neonatal mortality of Massa and Fulbe sheep breeds in a hot and dry environment, Cameroon. *Revue d'Elevage et de Medecine Veterinaire des Pays Tropicaux* **49**, 39-353.

Ellery, W.N., Scholes, R.J., Scholes, M.C., 1995. The distribution of sweet-veld in South Africa's grassland biome in relation to environmental factors. *African Journal of Range and Forage Science* **12**, 38-45.

Fynn, R.W.S., O'Connor. T.G., 2000. Effect of stocking rate and rainfall on rangeland dynamics and cattle performance in a semi-arid savanna, South Africa. *Journal of Applied Ecology* **37**, 491-507.

Gatenby, R.M., Doloksaribu, M., Bradford, G.E., Romjali, E., Batubara, A., Mirza, A., 1997. Comparison of Sumatra sheep and three hair sheep crossbreeds II. Reproductive performance of F_1, ewes. *Small Ruminant Research* **25**, 161-167.

Gautsch, K.D., 1992. Summary of results on station and on-farm sheep research in Ethiopian highlands. International livestock center or Africa (ILCA) Consultancy Report, Addis Ababa, Ethiopia. pp 133.

Hary, I., Schwartz, H.J., King, J.M., Carles, A.B. 2003. Effects of controlled seasonal breeding on reproductive performance traits of pastoral goat herds in northern Kenya. *Journal of Arid Environments* **55,** 555-579.

Holness, D., Patterson, R.,Ogle, B., 2005. Pigs In: Livestock and Wealth Creation: Improving the husbandry of animals kept by resource-poor people in developing countries. E. Owen, A. Kitalyi, N. Jayasuriya and T. Smith, (Ed). (Nottingham University Press, Hampshire, England.) pp. 343-360.

Kosgey, I.S., Baker, R.L.,Udo, H.M.J .,Van Arendock, J.A.M., 2006. Success and failure of small ruminant breeding programmes in the tropics. *Small Ruminant Research* **61**, 13-28.

Kyriazakis, I., Whittemore, C.T., 2006. Whittemore's science and practice of pig production. Third Edition, Blackwell Publishing Ltd, Oxford, United Kingdom.

Mapiye, C., M. Chimonyo., K. Dzama., J.G. Raats., 2008. Opportunities for Improving Nguni Cattle production in the Smallholder Farming Systems of South Africa. *Livestock. Science* **30**, 30-30.

Marufu, M.C., Chimonyo, M., Dzama, K., Mapiye, C., 2010. Seroprevalence of tick-borne diseases in communal cattle reared on sweet and sour rangelands in semi-arid area of South Africa. *The Veterinary Journal* **184**, 71-76.

Mashatise, E., Hamudikuwanda, H., Dzama, K., Chimonyo, M., Kanengoni, A.,2005. Socio-econimic roles, traditional management systems and reproductive patterns of Mukota pigs in semi-arid north-eastern Zimbabwe. *Bunda Journal of agriculture, Environmental Science and Technology* **3**, 97-105.

Montshwe, B.D., 2005. Factors Affecting Participation In Mainstream Cattle Markets By Small Scale Cattle Farmers In South Africa. Msc thesis, Department of Agricultural Economics, University of Free State, South Africa, pp. 1-20.

Muchadeyi, F.C., Sibanda, S., Kusina, N.T., Kusina, J., Makuza, S.M. 2005. Village chicken flock dynamics and contribution of chickens to household livelihoods in a smallholder farming area in Zimbabwe. *Tropical Animal Health and Production* **37,** 333-344.

Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P. E., Raats, J.G., 2008a. Tick Susceptibility and its effects on growth performance and carcass characteristics of Nguni, Bonsmara and Angus steers raised on natural pasture. *Animal* **2**, 298 – 304.

Muchenje, V., Dzama, K., Chimonyo, M., Raats, J.G., Strydom, P.E., 2008b.Meat quality of Nguni, Bonsmara and Angus steers raised on natural pasture in the Eastern Cape, South Africa. *Meat Science* **79**, 20-28.

Mukasa-Mugerwa, E., Lahlou-Kassi, A., Anindo, D., Rege, J.E.O., Tembely, S., Markos, Tibbo., Baker, R.L., 2000. Between and within breed variation in lamb survival and the risk factors associated with major causes of mortality in Indigenous Horro and Menz sheep in Ethiopia. *Small Ruminant Research* **37**, 1-12.

Narwade, V.E., Thorat, B.P., Deokar, D.K., Bhoite, U.Y., 1999. Effects of season on pre-weaning mortality in lambs of Deccani and its crosses. *Indian Journal of Small Ruminants* **5**, 31-34.

Nawaz, M., Khalil Ahmad, M., 1998. Comparison of Lohi and crossbreeds Ewes: productive and reproductive traits. *Small Ruminant Research* **27**, 223-229.

Ncube, M., Dzama, K., Chimonyo, M., Kanengoni, A., Hamudikuwanda, H., 2003. Effect of Boar genotype on reproductive performance of the local sows of Zimbabwe. *Livestock Research for Rural Development,* **15** (Number 2 February): http://www.cipav.org.co/Irrd/Irrd15/2ncub152. htm.

Ndlovu, T., Chimonyo, M., Okoh, A.I., Muchenje, V., Dzama, K., Raats, J.G., 2007. Assessing the nutritional status of beef cattle: current practices and future prospects. *African Journal of Biotechnology* **6**, 2727-2734.

Palanivel, K.M., Gajendran, K., 2006. Retrospective analysis of clinical diseases in sheep under farm condition. *Indian Journal of field Veterinarians* **2**, 22-24.

Peacock, C., Devendra, C., Ahuya, C., Roets, M., Hossain, M., Osafo, E., 2005. In: Livestock and Wealth Creation: Improving the husbandry of animals kept by resource-poor people in developing countries. Kitalyi, O.E., Jayasuriya, A. and Smith, T. N. (Eds), Nottingham University Press, Nottingham, United Kingdom, pp 361-385.

Rastogi, R.K., 2001. Production performance of Barbados black belly sheep in Tobago, West Indies, West Indies. *Small Ruminant Research* **41**, 171-175.

Reddy, M.P., Choudhuri, P.C., 1999. Study on lamb mortality in organised sheep farms in Andhra Pradesh. *Cheiron* **28**, 200-204.

Rumosa Gwaze, F., Chimonyo, M., Dzama, K., 2009. Communal goat production in Southern Africa. *Tropical Animal Health Production* **41**, 1157-1168.

Statistical Analysis Systems, 2007. Statistical analysis system user's guide (5th Edition), Version 6, (SAS Institute Inc., Raleigh, North Carolina, USA).

Scoones, I., 1992. The economic value of livestock in a communal area in Southern Zimbabwe. *Agricultural Systems* **39**, 339-350.

Scoones, I., 1995. Exploiting heterogeneity: habitat use by cattle in dry land Zimbabwe. *Journal of Arid Environments* **29**, 221-237.

Tainton, N.M., 1999. Veld Management in South Africa. University of Natal Press, Pietermaritzburg.

Tixeier – Boichard, M.., Ayalew, W., Jianlin, H., 2008. Inventory, characterisation and monitoring. Proceedings of the first international technical conference on animal genetic resource for food and agriculture. Wageningen Institute of Animal Science (The Netherlands). Animal Production Systems Group Animal Genetic Resources Information – Special issue. No.**42**, 29-47.

White, D.H., Lubulwa, G.A., Menz, K., Zuo, H., Wint, W., Slingenbergh, J., 2001. Agroclimatic classification systems for estimating the global distribution of livestock numbers and commodities. Environment International **27**, 181-187.

CHAPTER 5: General discussion, conclusions and recommendations

5.1 General discussion

The fact that sheep plays multiple roles and are essential to the resource poor farmer should not be overemphasized (Saico and Abul, 2007). Sheep productivity is seriously affected by production constraints such as lack of grazing, lack of production skills, feed storage, poor housing, diseases and parasites. For viable implementation of sustainable sheep production intervention, it is necessary to first evaluate the production practices, and the way in which farmers perceive such constraints that undermine sheep productivity and ascertain the major cause of lamb mortality (Mahanjana and Cronjé, 2006). Improved sheep productivity offers various benefits to the resource poor farmer that may result in earning better returns in terms of cash and nutritional status. It is of paramount importance to understand the features and characteristics of smallholder farmers and communal farming systems in order to come up with sustainable developmental plans. The information generated will assist in the understanding of the authentic involvement of sheep to household economy (Medina and Ramirez, 2005) rather than identifying constraints to sheep productivity in isolation. The main goal of this research was to determine the sheep production practices, constraints and productivity levels in communal areas of two different ecological zones. This goal was addressed through two trials.

The inherent roles of the different functions and products from sheep vary with regions, constraints, agro ecological zones, production methods, cultural values and socio economic status of the household (Devendra, 2001; Peacock, 2005; Kosgey *et al.*,2008). The roles and management systems of sheep in lowland and highland rangeland were assessed in Chapter 3. In Chapter 4, to determine the cause of lamb mortality, the main aim was on determining the quality of sheep raised by communal farmers in the two different agro-ecological zones. In

Chapter 3, sheep flock sizes was not different between the two villages of the Eastern Cape Province. There were significance positive correlations between sheep flock sizes and cattle herd sizes. High prevalence of diseases and parasites and high lamb mortality were some of the constraints experienced by the poor resource farmers across the two villages. However, high prevalence of diseases and parasites and high lamb mortality was more pronounced in the highland areas due to high rainfall. Fewer rams was another constraint to sheep productivity raised by farmers and this led to inbreeding and low lambing rate.

In Chapter 4, information on the contribution of sheep to household food security and income generation, sheep demographics in each community was captured. Lamb mortality was high in both villages. Its peak was in the month of May, probably due to cold, and in September when most of the lambs were born. The SPE values were low, regardless of high SPP in the villages. Higher SPP would probably mean that farmers were keeping their sheep for other purposes, for example wool production. The low SPE values indicated that farmers are not always willing to sell and/or consume their sheep. However, low SPE values do not signify that sheep are unimportant but that they are multifunctional. SPEs were higher in larger flocks compared to smaller flocks because of the greater number of sheep to dispose by owners of larger flocks. Availability and distribution of the rams affected the number of lambs that were born in any flock. Flocks that owned at least one ram had a higher proportion of lambs in their sheep flocks compared to those that did not own any ram.

Body condition scores, weights were collected from sheep in the upland and lowland rangelands, in the (cool-dry season), (hot-dry season), (hot-wet season) and (post-rainy season) the causes of the focus was to determine the quality of sheep raised by the communal farmers. Sheep in Gaga had better body condition scores and weights in hot-dry season

whereas sheep in Sompondo had higher weights and body condition scores in the post-rainy season. 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 (Ellery *et al.*, 1995).

5.2 Conclusion

Constraints faced by farmers from the two villages varied, shortage of feed and diseases/parasites were perceived to be the most important ones. Farmers keep sheep for income generation. Cross breeds were the most preferred sheep breeds by farmers. The reasons being their ability to resist diseases, high growth rate and high feed conversion efficiency. Complexity of sheep production systems in two ecologically different communal areas calls for the determination of efficiency of sheep production systems for devising interaction strategies as a driving force towards improved sheep productivity. Mortality was the major contributor to exits from the flock. Generally SPP was the same across the two villages. SPE was higher in large flocks in both villages. Body weights and body condition varied with season and agro-ecological area. Sheep production practices, constraints, flock dynamics, body condition and body variations in different agro-ecological areas need to be considered when planning strategies for sustainable sheep breeding programmes.

5.3 Recommendations

Based on current limitations it is recommended that, farmers can use breeds that are resistant to ticks and tick-borne diseases, such as Damara and Zulu, these can provide a key point for increasing sheep productivity in communal areas. Since availability of extension service and

education have strong influence on feed availability, educating farmers through extension, on cost effective ways of harvesting, conserving and value-addition of grasses, tree foliage and crop residues to improve their nutritive value, palatability, digestibility and utilization is important.

Areas that require further research include:

- ✓ Investigation of control and access to resources and benefits of sheep production by gender groups in the communal areas.
- ✓ Formulation of SPP and SPE model that consider all production out puts and contributions of sheep to livelihoods and social status of rural farmers.
- ✓ Evaluation of the potential of various community institutions to manage and monitor the use of the communally owned grazing resources should be investigated.

5.4 References

Devendra, C., 2001. Small ruminants: Imperatives for productivity enhancement improved livelihoods and rural growth. A review. *Asian-Australian Journal Animal Science* **10**, 1483-1496.

Ellery, W.N., Scholes, R.J., Scholes, M.C., 1995. The distribution of sweet-veld in South Africa's grassland biome in relation to environmental factors. *African Journal of Range and Forage Science* **12**, 38-45.

Kosgey, I.S., Rowlands, G.J.; Arendonk, J.A.M., Baker, R.L. 2008. Small ruminant production in smallholder and pastoral/extensive farming systems in Kenya. *Small Ruminant Research* **77**, 11-24.

Mahanjana A.M., P.B. Cronjé, 2006. Factors affecting goat production in a communal farming system in Eastern Cape region of South Africa. *South Africa Journal of Animal Science* **30**, 149–154.

Medina, A., Ramirez, G., 2005. The role of livestock in poverty alleviation: Analysis of Colombia. *Livestock Research for Rural Development* **17** (1).

Peacock, C., 2005. Goats-a pathway out of poverty. *Small Ruminants Research* **60**, 179-186.

Saico, S., Abul, S. 2007. Socio-Economic Constraints on Goat Farming In the Lowveld of Swaziland. *Journal of Sustainable Development in Africa* **9**, 37-49.

Appendix 1: Questionnaire for farmers

Questionnaire number.....

Name of respondent:…….....	Enumerator's name:…….....
Name of head of household:& age……...	District:…….....
Sex of head of household:…….....	Village:…….....
Date:……	
Farm type: a. communal /Villagised □, b. small-scale commercial□, c. large scale commercial□	

1. Demographic information

1.1. Is head of the household resident on the farm? Y/N

1.2. What is the size of the household?

Age group	**Males**	**Female**
Adults (>15 years)		
Children (< 15 years)		

1.3. Level of education for person responsible for flock sheets

Grade 1-4 □ Grade 5-7 □ Grade 8-10 □ Grade 11-12□ Other…….

1.3. What is the marital status of household head?

Single □ Married □ Divorced □ Separated □ Widowed □

1.4. How much income do you derive from the following sources?

Source	Salaries	Pension	Child maintenance	Disability grant	Home Industries	Child Support grant	Crops	Other/ Specify
Rand per month								

2. Livestock production

2.1. Which livestock species do you own?

Type of livestock	**Number**	**Rank according to importance**
Cattle		
Sheep		
Goats		
Chicken		
Pigs		
Ducks		
Donkeys		
Others (specify)		

2. 2. What is the composition of your sheep flock?

		Class				
	Ram	Ewe	Lamb	Gimmer	Wither	**Total**
Number						

2.3. Who owns the sheep? a. Father□ b. Mother□ c. Children□ d. Other (specify)…… □

2.4. How were the sheep acquired? a. Bought□ b. Exchanged □ c. Inherited□ d. Stud breeder□ e. Others (specify).....□

2.5. If sheep were bought, where did the money for purchase come from?

a. Bank (loan) □ b. Government subsidy□ c. Own capital□ d. Other (specify)…….....□

2.5.1. If you have received any government subsidy, how did you know about it?

a. Community meetings□ b. News paper□ c. Radio or TV□ d. Agric. officer□ e. Other (specify)……

2.6. What are your reasons for keeping sheep?

Reason	**Tick appropriate response**	**Rank**
a. Selling to raise income		
b. Household consumption		
c. Form of saving & investment		
d. Manure		
e. Socio-cultural function (e.g. lobola)		
f. Family pride & status		
g. Others (specify)		

3. Health Management

3.1**.** Do you have any sheep handling facilities? Y/N

3.1.1. If yes what type of materials did you use?

a. Logs with plain wire □ b. Treated poles with plain wire□ c. Logs with barbed wire □

d.Treated poles with barbed wire□ e. Steel poles with diamond mesh wire □

3.1.2. If no, explain how you handle your sheep during health management

……

……

3.2. Do you dip your flock? Y/N

3.2.1. If yes how many times?

In winter per month	In summer per month	Other/ specify

3.3. Do you deworm your flock? Y/N

3.3.1. If yes when do you dose and how many times?

Beginning of rain season	Mid rain season	After rain season	Other /specify

3.4. Are you experiencing any incidences of sheep mortality/ deaths in your flock? Y/N

3.4.1. If yes, tick and rank the main causes of mortality in your flock

Cause	**Tick**	**Rank**
a. Bad weather calamities		
b. Parasites		
c. Diseases		
d. Predators		
e. Others (specify)		

3.5. What are the common diseases in your area?

Local name and Scientific name	**Symptoms**	**Season of prevalence**	**Control**

3.6 What are common parasites in your area?

Local name and Scientific name	Symptoms	Season of prevalence	Control

4. Feeding & Housing Management

4.1. What grazing management system do you use?

a. Scavenging□ b. Intensive□ c. Semi-extensive□ d. Extensive□

4.2. What source of water do you have for animal watering?

A .Borehole □ b. Dam □ c. River □ d. Windmill □ e. Others (Specify) □

4.3. Who looks after the sheep?

a. Parents□ b. Children□ c. Hired labour□ d. Camp□ e. Other (specify)…….. □

4.4. Do you experience feed shortages? Y/N, when.....

4.4.1. If yes, how do you prioritise feeding during feed shortages?

Class	Priority
a. Feed rams	
b. Feed ewes	
c. Feed lambs	
d. Feed wethers	

4.5. Do you provide supplementary feeding for your sheep? Y/N

4.5.1. If yes, please provide the following information:

Class of animal given	**Type of feed given**	**Source of feed**
Rams		
Ewes		
Lambs		
Wethers		

4.5.2. If no, why? a. Expensive feed□ b. Not necessary□ c. Other (specify)…. ……..□

4.6. What are the reasons for feeding sheep?

Reason	**Tick**	**Rank**
a. Improve reproduction		
b. Improve growth rate		
c. Improve body condition		
d. Improve lactation		
e. Others (specify)		

4.7. Do you kraal your sheep? Y/N

4.7.1. If yes, what materials do you use for flooring?

a. Concrete□ b. River sand□ c. Other (specify)…. ……..□

4.7.2. What materials do you use for roofing? …….

4.7.3. What materials do you use for walls?.....

4.8. Are lambs kraaled separate from adults at night? Y/N

4.9. How many kraals do you have for you sheep?.....

5. Sheep Breeding

5.1. Which breeds of sheep do you keep?

a. Indigenous sheep.□ b. Exotic breeds.□ c. Cross breeds □

5.2. Which breed do you prefer?.....

5.3. Reasons for breed preference?

Reason	Tick	Rank
a. Fast growth rate		
b. Quality of meat		
c. Low feed cost		
d. Resistance to diseases		
e. Availability		
f. Quality of wool		
g. Colour		
h. Others (specify)		

5.4. What mating system do you practise? a. Hand mating □ Flock mating □ c .Group mating□

5.5. Which season do you prefer to mate your ewes?.....

5.6. Do you keep records? Y/N

5.6.1. If yes, why?.....

5.6.2. If no, why?:.....

5.7. Do you think government has done enough in improving communal sheep production Y/N?

5.7.1. If no, what do you think should be done?.....

6. Extension Delivery System

6.1. Do you have veterinary extension officers in your areas? Y/N

6.1.1 If yes, what is the distance to the service provider?.....km

6.1.2 What mode of transport do they use to reach you?.....

6.1.3. Which other organization has helped you in the production of sheep?

State.....

6.1.4. How do they intervene?.....

7. Marketing management

7.1 What are the major marketing channels available close to you?

a. Abattoir □ b. informal markets (communities) □ c. stock sales □ d. butcheries □

e. others (specify) ……..

7.1.1 On average, how many sheep do you sell per annum?.....

7.1.2 Which class of sheep do you usually sell?

Class	All sheep	Ewes	Rams	Lambs	heifer	Wethers
Tick						
Price						

7.1.3. At what time of the year do you usually sell sheep?

a. Summer□ b Winter□ c. Spring□ d. Autumn□ e. Anytime□

7.1.4. How much income do you derive from sell of wool per season?.....

7.1.5 What major constraints do you usually encounter in your sheep flock?

Constraints	**Rank**
a. Marketing	
b. Housing	
c. Diseases	
d. Feed cost	
e. Capital	
f. Professional knowledge	
g)Thefts	
h. Others (specify	

7.1.6. Which organisation has helped you in the marketing of your sheep or sheep products?.....

8. Animal Welfare

8.1. Do you experience some cold, hot and wet weather in your area? Y/N

8.1.1. If yes does it have any effects on your flock?

8.2. Are you experiencing some lambing mortalities? Y/N

8.2.1. If yes is it caused by a. Dystocia □ b. Starvation □ c. Mismothering □

d. Any other (specify)…….

8.3. At what age do you wean your lambs?

8.4. Do you shear your sheep? Y/N

8.4.1. If yes what do you use for shearing?

8.5. Do you experience some injuries from barbed wire, road accidents, predators, falls and shearing equipment in your flocks?

8.6. Are you experiencing some sheep scabs in your flock? Y/N

8.7. Do you castrate your male sheep? Y/N

8.7.1. If yes how is the operation done?.....

8.8. Do you dock your sheep? Y/N

8.8.1. If yes how is the operation performed?

8.9. Do you use dogs to herd your flock? Y/N

Appendix 2: Recording sheet for flock dynamics

Name of community……...
Name of Household……
Month…….
Year……

	Total	**Comments**
Herd composition		
Lambs (Amathole)		
Young rams (Inkunzana)		
Young ewes (Amathokazi)		
Wethers (Amadyongo / Iinkatyana)		
Growers (*Young ewe + growing rams*)		
Mature castrates (Iinkabi)		
Ewes (Iimazi)		
Mature Rams (Iinkunzi)		
Mature sheep (*reproductive ewes + mature rams*)		
Total number for all the sheep		
	Class	
Entries		
Births (Ezizelweyo)		
Purchases (Ezithengiweyo)		
Gifts-in (Izipho)		
Exchange-in (Ukutshintshisa)		
Entrusted-in (Ukunqoma/Ukusisa		
Exits		
Sold (Ezithengisiweyo)		
Slaughtered (Ezixheliweyo)		
Died (Ezifileyo)		
Predated upon /stolen/lost (Ezibelixhoba/Ezebiweyo/Ezilahlekileyo)		
Gifts-out (Ekuphiswe ngazo)		
Exchange-out (Ekutshintshiswe ngazo)		
Entrusted-out (Ukunqonywa/Ukusiselwa)		

Appendix 3: Sheep assessment form

Sheep assessment sheet

Name of household……

Household identity (A)

Month……..……

Animal Identity	weight	Age	Body condition score	comment
(Ewe)				
(Ram)				
(Wither)				
(Gimmer)				
(lamb)				
(Ewe)				
(Ram)				
(Wither)				
(Gimmer)				
(lamb)				
(Ewe)				
(Ram)				
(Wither)				
(Gimmer)				
(lamb)				
(Ewe)				
(Ram)				
(Wither)				
(Gimmer)				
(lamb)				