EVALUATION OF SHEEP PRODUCTION MANAGERIAL SYSTEMS AT SMALL-SCALE FARMS IN THE KING SABATA DALINDYEBO LOCAL MUNICIPALITY

by

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DECLARATION

I, Nwabisa Zizipho Langa, identity number _____ and student number _____, do hereby declare that this research project submitted to the Central University of Technology, Free State, for the Degree Master of Agriculture: Agricultural Management, is my own independent work and complies with the Code of Academic Integrity as well as other relevant policies, procedures, rules, and regulations of the Central University of Technology, Free State. It has not been submitted before to any institution by myself or any other person in fulfilment of the requirements for the attainment of any qualification.

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Nwabisa Zizipho Langa	Date

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ACRONYMS AND ABBREVIATIONS

AgriSETA	Agricultural Sector for Education and Training
ARC	Agricultural Research Council
DAFF	Department of Agriculture, Forestry, and Fisheries
DALRRD	Department of Agriculture, Land Reform, and Rural Development
DBSA	Development Bank of Southern Africa
DPIRD	Department of Primary Industries and Regional Development
FAO	Food and Agricultural Organisation
GCIS	Government Communication and Information System
GDP	gross domestic product
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPMS	improving productivity and market success
ISRDS	Integrated Sustainable Rural Development Strategy
LDS	Livestock Development Strategy
NWGA	National Wool Growers Association
PLAAS	Poverty, Land, and Agrarian Studies
SA	South Africa
SAMM	South African Mutton Merino
UFS	University of the Free State

ABSTRACT

Small-scale sheep farming in South Africa plays a vital role in supporting rural livelihoods, contributing to food security, income generation, and local economies. However, in provinces such as the Eastern Cape, production efficiency and profitability remain low, largely due to limitations in managerial capacity, access to resources, and technical support. This study aimed to evaluate sheep production management systems at small-scale farms in the King Sabata Dalindyebo Local Municipality. Specifically, the study sought to (1) identify the key challenges faced by farmers in managing sheep production, (2) determine the dominant management systems employed, and (3) assess the role of extension services and other support mechanisms in improving farmer practices.

Data were collected through structured questionnaires administered to 147 small-scale sheep farmers. Most respondents farmed with Dohne Merino (56.5%) and Merino (47.6%) sheep. The majority were male (57%) with varying levels of farming experience, although formal qualifications were limited—only 32.7% of respondents had tertiary education. Key management challenges included difficulty in identifying diseases (26.5%), livestock theft (24.6%), and the effects of drought (20.7%). Constraints also extended to infrastructure, access to skilled labour, and technical knowledge.

Regarding production systems, farmers practised basic management activities such as external parasite control (lice and mites: 44%; ticks: 35%) and vaccination, particularly against pulpy kidney (25.5%) and Rift Valley fever (19.4%). While most respondents (71.6%) provided supplementary feed to lactating ewes, only 35.8% tested rams for fertility. Animal replacement practices were inconsistent: 77.7% replaced rams, but only 35.1% replaced ewes, indicating a gap in long-term genetic and flock management planning.

Sales of sheep were primarily conducted through private buyers (55.3%) and feedlots (25.6%), while wool was mainly sold through BKB (76.4%) or agents (23.6%). About 63.5% of farmers employed workers, paying monthly wages ranging from R600 to R4000. Advice and technical support were obtained from extension officers (45.8%), fellow farmers (23.2%), and agricultural media (14.1%).

The study further analysed how selected management practices affected production outcomes, namely mortality rate and lambing percentage. Farmers who replaced ewes had lower mortality rates (mean = 63.86) and achieved an 8% higher lambing percentage than those who did not. Supplementary feeding of lactating ewes significantly reduced mortality ($U = 1384.50$, $p = 0.001$).

The study concludes that knowledge gaps contribute significantly to poor lamb survival. It recommends participatory extension interventions, better infrastructure, and targeted training to strengthen small-scale sheep farming. The role of agricultural extension services in improving efficiency and productivity is emphasised.

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1. CHAPTER ONE: INTRODUCTION

1.1. BACKGROUND

The first sheep in South Africa are said to have originated in South and Central Asia, from where they migrated to Egypt and then down throughout Africa, eventually arriving in the Cape (Hofmeyr, 1976). From the early 19th century, sheep farming expanded throughout South Africa, with the occasional decline in sheep production due to the invasion by the British into South Africa and the subsequent Anglo Boer War (Maree & Casey, 1993). A number of new breeds such as the Dormer were introduced in the market, and today Merino sheep are found in almost every district of South Africa, including the drier Northern Cape Province, together with other breeds such as the Dorper and Dorset Horn (Poggenpoel & Van der Merwe, 1987).

According to the World Bank Collection of Development Indicators (2014), approximately 80% of agricultural land in South Africa is suitable for extensive livestock farming. There are about 8,000 commercial sheep farmers and about 5,800 communal sheep farmers (DAFF, 2014). The estimated number of sheep in South Africa is 28, 8 million, with the Eastern Cape Province having the largest proportion at 29,3% (DAFF, 2012a). Reports (ISRDS, 2014; DAFF, 2017) show that the Eastern Cape is South Africa's premier livestock province and is home to more livestock than any other province. However, the contribution of livestock to the economy of the province is low according to a provincial farmer survey (Statistics South Africa [Stats SA], 2016). Despite its relatively small share of the total GDP, primary agriculture is an important sector in the South African economy (Obidike, 2011). Agriculture remains a significant provider of employment, especially in rural areas, and a major earner of foreign exchange (DAFF, 2014). Millions of people in rural South Africa depend on smallholder subsistence agriculture for their livelihoods, but the contribution of both subsistence and small-scale agriculture in improving the rural economy is not well studied in South Africa (Kleinbooi, 2010).

Under the leadership and guidance of the Wool Commission, South Africa is the fifth largest wool producer in the world today. The contribution of wool to the South African economy is second only to the gold mines (African Development Bank, 2015). The sheep breed with the highest wool production per head in South Africa is the pure-

bred Merino. The other dual-purpose Merino strains that are very popular are the Dohne Merino and the South African Mutton Merino (SAMM).

The annual wool production in South Africa is 45,000 tones (National Wool Growers Association [NWGA], 2012). Communal and emerging wool growers produce 12% of the national clip and are mainly located in communal areas of the Eastern Cape and the KwaZulu-Natal Province (DAFF, 2012b). In the Eastern Cape, sheep farming is predominantly found in the western and eastern regions of the province.

The study area for this research was the King Sabata Dalindyebo Local Municipality, which is located within the western region of the Eastern Cape, and this municipality's farmers are mostly farming with the Merino breed. In the western parts of the Eastern Cape Province, small-scale farmers have long been experiencing the problem of poor sheep production, without an apparent solution to this problem, and some farmers do not even realise that they have a problem (DAFF, 2016). Effective solutions require that the source of the problem is identified and solutions are designed accordingly.

1.2. PROBLEM STATEMENT

In South Africa, small-scale farmers are confronted with many constraints that hinder them from contributing to the economy; poor management skills are one of the biggest hindrances to these farmers. These poor management skills are based on inadequate knowledge and lack of information (Aina, 2007; Mthembu, 2013). Over the years, rural farmers have depended solely on indigenous or local knowledge to improve farming systems and animal husbandry (Obidike, 2011). Such knowledge refers to skills and experiences passed down through generational teaching and practical demonstration, and the application of this traditional knowledge by rural farmers has not significantly improved their agricultural yields (Obidike, 2011). The present study was thus designed to identify the constraints/challenges that hinder small-scale farmers in the King Sabata Dalindyebo Local Municipality from practising better animal husbandry techniques.

Poor sheep-management practices negatively impact the production of emerging farmers in the Eastern Cape, primarily due to factors such as reliance on indigenous knowledge and resistance to adopting new technologies and management skills. A literature review revealed a lack of documented studies on sheep-management

practices among small-scale farmers in the King Sabata Dalindyebo Local Municipality. This research aimed to identify the challenges faced by these farmers that lead to poor management practices and to propose solutions to improve their situation. These recommended solutions were then also communicated to the farmers.

1.3. OBJECTIVES OF THE STUDY

The broad objective of the study was to identify problems in the management of sheep production in the King Sabata Dalindyebo Local Municipality faced by small-scale farmers. The sub-objectives were to:

- To identify and analyse specific constraints faced by small-scale sheep farmers in managing human resources, finances, natural resources (e.g., grazing and water), infrastructure, and enterprise-specific skills and knowledge.
- To determine and describe the dominant sheep production and management systems currently practiced by small-scale farmers in the King Sabata Dalindyebo Local Municipality.
- To investigate and highlight the potential role of agricultural extension services, farmer-to-farmer learning, and industry support in strengthening the managerial capacity of small-scale sheep farmers.

1.4. HYPOTHESIS

Inadequate managerial skills among small-scale sheep farmers in the Eastern Cape significantly contribute to poor production and reproduction rates.

2. CHAPTER TWO: LITERATURE REVIEW

2.1. INTRODUCTION

Sheep production in South Africa is highly prominent in the Eastern Cape Province (DAFF, 2013), which is the broad context of the selected study area. A literature review was conducted to identify studies focusing on small-scale livestock/sheep famers, their impact on the economy, and how they can be more financially efficient. Poor rural households are constantly in a struggle to make ends meet; food security and family living expenses constitute some of the major priorities of these households (Van Rooyen, 2008). Globally, agriculture provides a livelihood for more people than any other industry, and since most of the world's poor live in rural areas and are largely dependent on agriculture, it plays a role in reducing the poverty in these rural areas. Small-scale livestock systems play a very important role in supporting rural livelihoods. According to Smith *et al*. (2013), livestock production is an indispensable part of the solution to global food security, and a reasonable amount of the world's food supply comes from these communal, small-scale systems in which livestock is an important aspect. Accordingly, this study aimed to investigate sheep production, including all the systems involved and the nutritional aspects affecting small-scale farmers' productivity.

The King Sabata Dalindyebo Local Municipality has many emerging agricultural farmers and contributes to the local and national economy, with many households practising backyard farming to improve food security and access to food. Research data released by Stats SA in 2016 indicated the number of households engaged in agricultural activities to assist them to survive in the respective provinces. The highest proportion of households that were engaged in agriculture in 2016 was 27,9% in the Eastern Cape, down from 35,4% in 2011. This was followed by 24,1% in Limpopo (33,0% in 2011) and 18,6% in KwaZulu-Natal (28,2% in 2011). The Western Cape and Gauteng recorded the lowest participation rates, with 3,6% (5,2% in 2011) and 4,9% (7,1% in 2011) of households involved in agriculture, respectively. Nationally, 13,8% of households were involved in agriculture in 2016.

2.2. ROLE OF SHEEP PRODUCTION IN THE PROSPERITY OF SOUTH AFRICA

The South African government, through the Livestock Development Strategy (LDS), is working to end poverty and food insecurity in the country by enhancing the productivity of smallholder livestock farmers. Expanding the livestock industry will lead to employment, improved income, and socio-economic development in the country – particularly in rural areas where livestock production dominates (Department of Agriculture, Forestry, and Fisheries [DAFF], 2014). The livestock sub-sector in developing countries contributes more than 33% to the agricultural gross domestic product (GDP) and is also one of the fastest growing agricultural subsectors, a major contributor to food and nutrition security, and an important source of livelihood for nearly 1 billion poor people in developing countries (Swanepoel & Moyo, 2010). In addition, it is anticipated that the livestock sector will become the world's most significant agricultural sub-sector in terms of value addition and land use (Van der Zijpp *et al.*, 2010).

Most (69%) of South Africa's land surface is suitable for grazing, and livestock farming is by far the largest agricultural sub-sector in the country (Goldblatt, 2013). Livestock can be described as all domesticated animals that are intentionally reared in an agricultural setting for food, fibre, or breeding purposes (Ntshepe, 2011). Livestock systems occupy about 30% of the planet's dry land surface area (Steinfeld *et al.*, 2006*).* Sheep and goat farming occupy approximately 590,000 km^2 of land in South Africa. This represents 53% of all agricultural land in the country and includes the vast Karoo areas of the Northern and Western Cape provinces and the mixed veld types of the Eastern Cape and Southern Free State. Commercial sheep farms are also found in other areas such as the Kalahari, the winter rainfall areas, and the grasslands of Mpumalanga, Eastern Free State, and KwaZulu-Natal, where other farming types, such as cattle farming, are also practised.

South Africa has a dual agricultural economy – with both well-developed commercial farming and more subsistence-based production in the deep rural areas – which plays an important role in poverty alleviation. Primary agriculture contributes about 3% to South Africa's GDP and about 7% to formal employment. However, there are strong linkages to the economy, with the agro-industrial sector comprising an estimated 12% of the GDP (Government Communications South Africa, 2013).

In the Eastern Cape, agriculture plays a major role in sustainable rural development, with crop production and livestock farming being used to maintain food security. Stockbreeders concentrate mainly on developing breeds that are well adapted to diverse weather and environmental conditions. Many stockbreeders in households engaged in agriculture are farming on communal land, and according to Stats SA (2016), 38% of the households engaged in agriculture in the Eastern Cape are farming with more than one type of animal.

2.3. CONSTRAINTS FACED BY SMALL-SCALE FARMERS

According to Zenda and Malan (2024), common constraints facing smallholder farmers in developing areas can be classified as either external or internal constraints. External constraints emanate from the broader agricultural environment and are largely beyond the control of the individual farmer. These include risks typical to agricultural activity – namely, limited availability of inputs, credit, mechanisation, and marketing services; poor institutional and infrastructural support; inappropriate policies and legislation; restrictive administrative and social structures; and problems associated with land tenure and the acquisition of agricultural resources. Internal constraints are those that affect the farmer's ability to operate efficiently; despite any innate potential, the farmer might have to allocate resources in an economically efficient manner. Normally, the farmer has some control over these constraints. These include liquidity problems; shortage of workers; lack of skills, knowledge, and education; and a range of cultural factors that, in some instances, prevent more effective management of resources. The removal of these constraints will assist the farmer in allocating resources in an economically optimal manner. The challenge for small-scale farmers is to acquire new skills and knowledge to respond to their ever-evolving circumstances. The areas of land they cultivate are relatively small and usually situated far from roads and extension services (Afenyo, 2013).

Inadequate and poor-quality feed resources (especially during the dry seasons) are the most serious constraint to sheep production (Nyam *et al.*, 2022). A shortage of drinking water is another major constraint to sheep production, while poor management and poor husbandry are common in production systems. Sheep produced under mobility are less fertile, less prolific, and constrained by higher lamb mortality compared to sheep raised under agro-pastoral or semi-intensive systems.

Poor interaction among researchers, farmers, extension workers, and policymakers is a major obstacle to improved sheep productivity (Aliber & Hall, 2010). Animal diseases constitute one of the principal constraints to smallholder livestock production in the developing world. High incidences of diseases may dramatically reduce productivity, while the risk of disease restricts further investment and intensification in livestock production. Smallholder livestock keepers fail to manage livestock diseases effectively because existing disease-control technologies are not appropriately designed and have not been made available, or because the appropriate technologies have yet to be developed. Epidemic and endemic diseases continue to represent major constraints to livestock productivity in large parts of the developing world (Munyai, 2012).

Smallholder farmers in South Africa face various challenges that impede their growth and their ability to effectively contribute to food security relative to commercial farmers. Some of the constraints they face relate to a lack of access to land and poor physical and institutional infrastructure. Most smallholder farmers are located in rural areas and mostly in the former homelands, where the lack of both physical and institutional infrastructure limits their expansion potential (DAFF, 2012b). According to Afenyo (2013), poor performance of small-scale farming and the lack of improvement in farmers' situations are due to the type/extent of support they have received, and continuing to receive it does not address the totality of their needs. Nyam *et al.* (2022) argue that some of the challenges facing African smallholders are a lack of markets, high transaction costs, and poor production (Louw *et al.*, 2007). Poor technological skills can be a serious obstacle to accessing useful formal institutions that disseminate technological knowledge (World Bank, 2008). High transaction costs also result from information inefficiencies and institutional problems such as the absence of formal markets (Samuels *et al.*, 2021). The lack of continuity in the chain of support in terms of production and market access has contributed to denying small-scale farmers the benefits they should derive from their farming activities.

2.4. SHEEP-MANAGEMENT SYSTEMS

There are two major sheep-management systems that are used throughout the world for sheep production – namely, extensive production for wool and meat and traditional pastoralism (Kilgour *et al.*, 2008). Production systems for sheep vary from extensive

free ranging to controlled grazing or zero-grazing feedlots. The type of system in use depends on the environment, product, the degree of control required, and the preferred management programme (Rust *et al.*, 2022). The extensive management systems for sheep production are the most common in all sheep-producing countries, and extend from lowland farming systems, where relatively small flocks graze fenced enclosures, to rangeland management systems, where large flocks live on unfenced pastures. Flock size, the ratio of sheep to shepherds, and specific management practices follow local norms (Kilgour *et al*., 2008).

In the semi-intensive systems in South Africa, the flock consists of dual-purpose sheep or wool-type breeding ewes running on the veld with feed supplements or crop residues. With dual-purpose sheep, all lambs are sold in February (end of summer), and none are retained as wethers. However, on wool-type ewes, they are mated in spring, and lambs are put on pastures in winter and sold off the veld in February. Furthermore, a proportion of the flock consists of wethers running on veld for wool production (Smith, 2006). Zanda and Malan (2021) indicate that the extensive grazing system is mostly used in areas of low rainfall with sparse vegetation of xerophytic and succulent shrubs, with mainly annual grasses, most of which are palatable and have high nutritional values. In more moderate climatic areas, sheep and goats are grazed either separately or in combination with cattle, since each species grazes or forages a different spectrum of herbage.

The intensive grazing system provides dry matter needed for animal production. However, it holds the potential to improve production dramatically, even to the extent of 50% in total animal live weight per hectare in areas of good rainfall (Meissner *et al.*, 2020). In addition, Smith (2006) states that an intensive grazing system is good for fat lamb production on pastures, with ewes mated in spring and re-mated in autumn. These systems have their challenges, including increased cost structures, and it is important to be aware of the issues surrounding them. The feeding of animals in these systems is much more critical than in an extensive system and must be properly managed to prevent unlimited expenses, while the animals need to be fed the correct feed according to their increased needs (Kilgour *et al*., 2008).

2.5. SMALL-SCALE FARMERS

In South Africa, the agricultural system has always been dual in nature, with two sectors existing along parallel lines – the small-scale farming sector on the one hand and the commercial farming sector on the other. The small-scale farming sector comprises small farms that use traditional production techniques that are labour intensive and lack institutional capacity and support. Commercial agriculture is inclusive of farms that have relatively high turnovers and use modern production techniques that are capital intensive and have links with key input and output markets (Greenberg, 2010). In South Africa, agricultural production has primarily been dominated by commercial farms. There are approximately 50,000 large-scale commercial farmers in South Africa, who are predominantly drawn from the white population. They employ about 1 million workers, which is 11% of the total formal-sector employment in the country (Stats SA, 2011). Many of these workers live on commercial farms, and their children receive education in farm schools. These commercial farms provide livelihoods and housing to about 6 million family members of these 1 million employees and provide for their education needs.

Small-scale or smallholder agriculture in Africa has characteristic features that distinguish it from large-scale agriculture. In general, smallholder agriculture, which is not homogeneous, is a low-input and low-output system with wide social dimensions impacting positively or negatively on productivity. However, small-scale agriculture is the linchpin of rural development in many African communities (Makapela, 2009). Small-scale farmers in South Africa have been subjected to years of official neglect, despite numerous policies and programmes that proclaim the opposite. In particular, dismantling Bantustan agricultural-development corporations in the 1990s, despite all their faults, left a vacuum in production and marketing support for the estimated 200,000 commercially oriented smallholder farmers and 2.5 million households currently practising agriculture mainly for subsistence purposes (Aliber & Hall, 2010).

Small-scale agriculture is the production of livestock on a small piece of land without using advanced and expensive technologies. Although the definition of the size of these farms is a source of debate, it can be argued that farming on family pieces of land, on traditional lands, and smallholdings on the periphery of urban areas fall into this category. This type of farming is usually characterised by intensive labour and, in most cases, by animal traction, limited use of agrochemicals, and supply to the local

or surrounding markets. Unlike large-scale commercial agriculture, it plays a dual role of being a source of household food security as well as a source of income from the sale of surplus. Recent research confirms that small-scale agriculture typically demonstrates lower profit efficiency compared to commercial farming systems (Mofokeng & Seerane, 2022).

2.6. IMPORTANT ASPECTS OF GOOD MANAGEMENT PRACTICES

Good management practices (health programmes, feeding, breeding, and housing) are necessary in any sheep-farming enterprise to prevent disease and production losses. Some methods can result in a short period of distress, but not performing them may result in far more pain and distress to the animal than the technique itself, if it is done at the right time and expertly (Makapela, 2009). The practices that may lead to pain should be applied in such a way as to minimise discomfort and should not be carried out if practical replacements can be used to accomplish the same results. Skilled persons should apply management techniques carried out on sheep, and the related hygiene protection should be utilised (Makapela, 2009).

In an organisation, effective management is very important for the business to prosper. Van der Westhuizen and Mbatha (2018) indicate that management is necessary to steer an organisation to achieve objectives. Without the input of a manager, the resources of the enterprise will not be directed towards achieving balanced operations in the organisation. In the microenvironment of the organisation, a balance should exist between the objectives of the organisation and the resources available to achieve these objectives, the personal goals of employees, and the interest of the owners.

According to Makapela (2009), flock management relates to factors such as feeding, sickness and parasite control, breeding and breeding methods, as well as the handling of animals. Flock-management practices determine how the genetic potential of a flock is realised. Good knowledge of grazing, feeding, and animal production is of cardinal importance. Management means to lead and to have control over something going in a particular direction. Any organisation consists of people and resources striving for specific objectives. The people, equipment, and expertise in the organisation are important elements required to enable and steer the resources and activities to achieve the objectives. Without management, focus-orientated actions are not possible (Makapela, 2009). In order for small-scale farmers to be lucrative,

management skills must be in place. These management skills comprise the key elements discussed in the following sections.

The agricultural sector can be improved and expanded by ascertaining the specific constraints to its development, with emphasis on institutional, technical, and entrepreneurial factors in particular. Understanding the technical constraints affecting smallholder farmers in South Africa remains one of the critical areas for providing a sound basis for investment in order for agriculture to realise its full potential as a vehicle for poverty reduction and enhancement of the standard of living for poor South African people (Raphela, 2014).

A few key activities forming part of good management practices in sheep production are discussed below.

2.6.1. Preparation of Ewes for Mating

For the management of this aspect, every sheep on the farm must have a clear and permanent number. As ewes sometimes run in one large flock, a permanent numbering system is important in order to distinguish between individual ewes. When the lambs are weaned from the ewes, the ewes are dry, and they have to get into the necessary condition in order to be synchronised again within four weeks. At that point, it is important to examine the ewes and check their udders, teeth, and hooves. This is done to ensure that they are in an ideal condition and status for the next mating. If decided on and if the weather allows it, ewes can also be sheared at this stage (Wessels, 2011).

Ewes should be in a good condition and on what is called a "rising plane of nutrition" prior to and during breeding. Too fat is not good, and too thin is not good either. If the ewes are working hard to feed twins, it is important to wean them in time to put some weight back on before breeding. They should have a body condition score of 2.5 to 3 when the rams go with them and continue on reasonably good feed for at least a month after. After that, the farmer is essentially feeding the ewe as well as the lamb/s that she is carrying; therefore, it is not advised to cut back too much on feed quality. The ewes should be managed throughout gestation and closer to lambing (Moran, 2014).

2.6.2. Feed

Sheep should have access to good feeding that is nutritionally suitable to sustain health and meet the correct physiological requirements for pregnancy, growth, fertility, lactation, and withstanding cold exposure (Mushonga *et al*., 2018). In any system of management, persistent assessment should be made of the needs of the sheep in relation to the amount, quality, and continuity of feed supply. In the case of full feeding, diets should be formulated by a professional animal nutritionist to prevent metabolic disorders and the unnecessary discomfort, pain, and deaths that could result (Moyo *et al*., 2021). As far as possible, sheep should not be exposed to toxic plants and other substances suspected of being deleterious to their health. Feed must be of good quality and free of poisonous plants and seeds (Makapela, 2009). The use of animal by-products must be avoided.

2.7. BREEDING METHODS

Animal breeding is a branch of animal science that addresses the evaluation of the genetic value of domestic livestock. A breed is a group of domestic animals with homogeneous appearance, behaviour, and other characteristics that distinguish them from other animals (Schoenian, 2011). According to Dalton (2009), there are different methods of breeding livestock. Sheep normally attain full growth at the age of two years; however, this may vary from 18 months to three years with different breeds and localities. Ewes of age 18–24 months are generally used for mating. The rams are mature at one year of age, but it is desirable to use rams for mating from two and a half to seven years of age (Khanvilkar *et al*., 2009). In the Eastern Free State, some of the different breeding methods used are pedigree breeding, crossbreeding, interbreeding, inbreeding, and line breeding.

2.7.1. Reproduction and Production

Reproduction is the biological process by which new individual organisms – offspring – are produced from their parents. Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction (Johnson, 2007). Sheep production is the core focus of this study; for efficient sheep production, farmers need to know the best practices of reproduction to gain maximum yield on production. In their natural state, sheep are seasonal breeders; offspring are born at the time most

favourable for their survival. In some domestic sheep, the breeding season has been altered both naturally and through the use of hormones (Kafi *et al*., 2018).

The productivity of smallholder farmers, especially in the livestock sector, is low and, as a result, studies have investigated the factors affecting these farmers' inability to produce at full capacity. Certain factors have been identified to cause low productivity in this sector. This section will review some of the factors that affect the productivity of smallholder livestock farmers, with particular reference to smallholder sheep farmers in South Africa and Africa in general. The factors can be sub-divided into production, inefficiency, and socio-economic factors (Nyam, 2017).

Reproduction and production are interlinked; for effective reproduction, effective production is required. One must always strive for improvement; the offspring of the respective parents must always be better than the parents in terms of intended traits to be improved during reproduction. Production of high-quality and -quantity stock should be the goal. Increased efficiency is an important factor in productivity growth, especially when productive resources are scarce and smallholder farmers are living in extreme poverty. Maximising outputs while minimising inputs is a technical problem faced in Africa, especially by smallholder farmers (Nyam, 2017).

2.7.2. Water Provision

Sheep should have access to sufficient good-quality water. Regular assessments should be done of the quality and quantity of water sources, with particular attention focused on the special needs of lactating sheep, feedlot lambs, and sheep in hot weather (Moyo *et al*., 2017). The watering points should be of adequate capacity and allow safe access. The mechanical equipment controlling the delivery of water – including dams, rivers, windmills, and boreholes – should be inspected regularly (more frequently in hot weather conditions) and kept in proper working order (Lesoli, 2008). The quality of water provided should be adequate to maintain sheep health. The voluntary water consumption of adult sheep is 2 or 3 times dry matter consumption, and it increases with high-protein and salt-containing diet (Lesoli, 2008). Drinking of water which contains potentially toxic levels of salts or other harmful substances should be supervised and managed to reduce dangerous effects. Wherever adequate, good-quality water to maintain health cannot be provided, the sheep should be moved to other areas where an adequate supply is available. As a guide, sheep should not

be deprived of water for more than 24 hours. This period should be reduced in the event of hot weather (Steyn, 1999).

2.7.3. Nutrition for Good-Quality Wool

The wool growth of Merino sheep will respond to changes in nutrition throughout the year, but breeds with a large inherent rhythm in wool growth rate, such as the Scottish Blackface, show little or no response to changes in nutritive status during winter (Kyriazakis *et al*., 2018). There is no general agreement on the precise form of the relationship between wool growth and feed intake. Kyriazakis *et al*. (2018) concludes that available evidence points to a positive linear relationship between intake of digestible dry matter and wool growth and states that there is no unequivocal evidence for a straight relationship, although this may occur at rates of wool growth approaching the genetic potential (Brown & Miller, 2017). It has been suggested that wool growth rate is influenced by the extent and direction of body weight change. However, Kyriazakis *et al*. (2018) has concluded that there is no convincing evidence that weight change has any effect on wool growth rate.

2.7.4. Preparation of Breeding Rams

For identification purposes of ewes which are bred by rams, it is essential that rams have on their brisket, which at the time of mating will mark the ewe at the rump. Either lamp black or Venetian red paint is mixed with linseed oil to make a paste, which is then applied to the brisket area at least once a week. During the course of breeding, the ewe will be marked on the rump (Khanvilkar, *et al*., 2009). Rams need to have good feet and also have good body condition so that they can afford to lose weight during the busy mating season. However, more important than these factors is the fertility of the ram. Rams must be tested for fertility at least once a year, but preferably more frequently. The testes should be examined during every test in order to check for abnormalities. Rams play a vital role in the intensive production system, as one ram is responsible for all the ewes it is paired with. Any problems with the rams will have major consequences for the whole system. It is also preferable to have two groups of rams, with one group covering ewes every second month. This is preferable, as the formation of sperm takes six weeks, and an overworked ram is not efficient in the long run. The rams must also be fit in order to achieve the best results. If rams are

not getting along with one another, it is best to separate them to avoid any injuries (Gebremedhin *et al*., 2007).

Before the breeding season starts, the wool should be completely removed from all over the body of the ram. He should at least be clipped from the neck and from the belly, particularly at the region of the penis. This process is referred to as ringing and makes proper mating easier for the ram. Infections that increase the ram's body temperature in the two-month period up to mating can render the ram infertile. For this reason, it is a good idea to have the ram flock assembled in one point at least two months prior to mating so that any potential problems are identified in time and, if required, replacement rams can be used (Moran, 2014).

2.7.5. Breed Selection

During selection of breeds, knowledge of the breed and the area in which the farming activities will take place is very important. According to Sachse (2012), the most appropriate sheep breed depends on environmental conditions, the producer's desired management intensity, and personal preference. It is evident that Merino breeds adapt well in the Eastern Cape. As most farmers farm with them for accelerated sheep production, it might be necessary to use three or more breeds to develop a ewe flock that exhibits acceptable levels of desirable traits. Accelerated flocks must be able to lamb out of season, produce large lamb crops, reach sexual maturity at an early age, and grow rapidly (Thompson, 2006).

The selection of good breeding animals is vital for a successful sheep-production enterprise. Selection of superior breeding animals is the basis of sheep improvement programmes. Only through superior animal productivity can enterprises be sustainable and profitable. A successful selection programme should focus on economically important traits identified to meet the goals of the enterprise. To do this, a sheep farmer or pastoralist should select breeding stock based on performance records of traits that can be readily measured and accurately evaluated (Gipson *et al*., 2007).

A farmer selects breeds to improve economically important traits, such as growth rate and wool quality. In the present commercial environment, the need for selective breeding decisions is as important as ever. It is, however, not possible to select for several characteristics at the same time; farmers must choose a specific characteristic and select the animals accordingly. The animals that do not display this characteristic

must be culled and slaughtered or sold. Sheep producers can only maintain their businesses by producing lambs that meet market specifications in terms of carcass weight, fat class, and conformation. Allied to this is the need to monitor production costs to ensure lambs are produced efficiently and the flock will generate a positive financial return (HCCMPW, 2004).

2.7.6. Impact of Climate Change on Productivity

Livestock production is vulnerable to climate variability and change (Intergovernmental Panel on Climate Change [IPCC], 2007). According to Maponya and Mpandeli (2012), the impact of climate change in Africa is expected to exacerbate the vulnerability of livestock systems and reinforce the existing factors that are simultaneously affecting livestock production systems, such as rapid population and economic growth, increased demand for food (including livestock) and products, and increased conflict over scarce resources (i.e., land tenure, water, and biofuels). This also supports the view of Delgado *et al.* (1999) that livestock systems in Africa are changing rapidly in response to a variety of drivers. Of the numerous factors that affect the productivity of livestock (sheep) farmers, climate change and location are significant. Livestock production exacerbates climate change, and climate change, in turn, also poses a serious threat to the ecosystem and global livestock production. Changes in climatic conditions such as temperature and rainfall can result in extreme natural occurrences, such as drought, floods, and windstorms, which are believed to affect the productivity and overall performance of livestock in terms of vulnerability to diseases, decreased birth and growth rates, and feed and water availability (Nyam, 2017).

Climate change is one of the biggest challenges constraining smallholder agriculture in sub-Saharan Africa because of extreme weather conditions associated with climate variability. The region's agricultural sector is highly sensitive to future climate shifts and increasing climate variability. Agriculture remains an important livelihood source for most rural sub-Saharan communities, providing employment for over 60% of its inhabitants and accounting for an estimated 30% of its GDP. The region experiences high temperatures and low (and highly variable) rainfall, the economies are critically dependent on agriculture, and adoption of modern technology is still low (Kruger & Shongwe, 2004).

2.7.7. Grazing Management

Grazing management is an important tool in the efficient utilisation of pasture resources. Appropriate choices of stocking, height of grazing, and rotational or continuous stocking are critical to the success of a grazing system (Sollenberger *et al.*, 2009). This communal system is under criticism in terms of exceeding the grazing capacity of the land and risking rangeland degradation (Palmer *et al.*, 1999; McGranahan & Kirkman, 2013). Land degradation has been researched by various scientists in recent years and can be defined as a decrease in either or both the biological productivity and usefulness of a particular area due to human interference (Montanarella *et al*., 2016). It is also described by Ma *et al*. (2020) as the process by which habitat quality for a given species is diminished.

Overgrazing is considered to be the most important cause of rangeland degradation in Southern Africa (Van der Westhuizen *et al.*, 2005). The effect of grazing management on the ecosystem structure and function are inconstant, yet grazing intensity appears to be the most important driver of net primary productivity and composition, especially in semi-arid regions (Briske *et al.*, 2008). When the production potential of rangelands is over-estimated, the subsequent overgrazing will cause a decrease in palatable perennial plants in favour of less palatable and undesirable vegetation.

Communal farming differs distinctly from commercial farming in terms of production systems, objectives, and property rights (Smet & Ward, 2006). Communal production systems are based on pastoralism, with members of a community sharing the grazing areas. There are often unclear boundaries, with continuous grazing being practised. Rotational grazing as well as continuous grazing systems can co-exist, depending on the specific community's way of thinking at a particular time (Lohmann *et al.*, 2014). The outputs and objectives of livestock ownership are diverse and include draught power, milk, meat, dung, cash income, capital storage, as well as socio-cultural factors. Higher stocking rates in communal areas are common (FAO, 2005).

It is generally understood that veld-management practices cause either the deterioration or improvement of the veld. Various veld-management systems are advocated, and there is no single ideal system that applies to all veld types. A practice that undoubtedly improves veld production, veld composition, and animal production

is the implementation of a full rest during the growing season every second or third year. Seasonal rest not only allows plants to rest but also to recover by building root reserves (Nel *et al*., 2010). According to the Saskatchewan Ministry of Agriculture (2008), a grazing-management plan must be designed with both plant growth and animal performance in mind, and there must be a balance between plant and animal requirements in order to ensure long-term sustainability.

According to Munyai (2012), livestock systems are the largest land-use activity on earth. In developing countries, aside from the fact that livestock may be kept in the vicinity of the house or common land and fed with residue, there are also several other reasons why livestock is kept. Sheep are more selective and tend to prefer grazing on forbs (broadleaf plants). Multi-species grazing can benefit the producer with better economic gains (different markets), predator protection, and improved range health (Baron *et al.*, 2012). Small ruminant production is the main source of income for farmers living in arid and semi-arid regions. Sheep and goats raised in these areas are generally confronted with severe nutritional deficits during periods of food scarcity, which exacerbates the occurrence of diseases and health problems and, consequently, leads to low productive and reproductive performance.

2.7.8. Record Keeping

The important role of keeping accurate records is to measure quantities. It is no use to, for example, guess the area of land or yields. Land should be measured using measuring instruments, and yield of products should be weighed. The whole purpose of keeping records and accounts is to make improvements. There is no value in spending time keeping records and doing calculations related to profit and production in individual enterprises if the results are not utilised and compared with objective standards (Hemito, 2009).

Without records, it is impossible to address the production and management practices that affect overall productivity. With records, the tools are in place for good decision making, problem solving, identifying management priorities, and setting production and marketing goals (Greiner, 2009). There is no one sheep-production system that will be profitable, competitive, and sustainable for everyone (Thomas, 2012).

2.7.9. Animal Health

Animal health is an important component in animal welfare. Animal health can be affected by many factors, including nutrition, ventilation, housing, and management practices. An animal's well-being is also impacted by pain and discomfort – often caused by health issues. Good animal welfare, therefore, requires good animal health (Nordquist *et al*., 2013). Maintaining healthy flocks and minimising diseases should be the goal of every sheep farmer; this goal can be accomplished by combining superior nutrition, timely management, and appropriate health practices (Radostits *et al*., 2017). Livestock farming depends largely on the health of the livestock and, if more is spent on drugs for the livestock, productivity will be enhanced, since the healthier the livestock, the greater the output of the animals (Nyam, 2017). Diseases and health problems in sheep are closely associated with poor management and nutrition. Medication cannot cure the results of poor management and poor nutrition. In addition to good management practices and nutrition, the first step in controlling a disease problem is to identify the disease. Producers should seek professional help from a qualified veterinarian. Autopsies and accurate health records can be helpful in improving the overall health programme. Any time drugs are administered to livestock, it is imperative that the drugs are used strictly as directed on the label, unless otherwise directed by a veterinarian (William, 2005).

2.7.10. Meat Production

Mbatha and Muchenje (2021) regard sheep meat as a valued food item in Africa, with the average price per kilogram being up to 25% more than for beef. More than 70% of sheep are marketed as lambs. Consumer preferences for lean carcasses favour the later-maturing breeds like the SA Mutton Merino and the Ille de France. In South Africa, sheep are slaughtered, and the meat is used in traditional ceremonies or for lobola, in addition to the more common use of sheep to generate income from milk, skins, wool, mutton, and lamb. Furthermore, almost every part of the sheep is useful for household consumption.

Meat consumption in South Africa has expanded rapidly over the past decade, and while continued growth in meat consumption is projected in the coming decade, slower economic growth will result in slower consumption growth relative to what existed in the past. South Africa's economy is expected to grow by less than 2% in the next three years, as lower commodity prices, labour unrest, weak exchange rates, and prospects

of a weaker global economy will impact negatively on economic growth. Economic growth is the main overall driver for an increased demand in meat (DAFF, 2014).

2.8. CONCLUSION

In this chapter, the literature explored has provided compelling evidence that small-scale farming has the potential to reduce poverty in rural areas. However, the literature also shows that small-scale farming is constrained by several challenges that need to be addressed in order to increase the success of farming enterprises and decrease poverty.

3. CHAPTER THREE: RESEARCH METHODOLOGY

3.1. INTRODUCTION

The purpose of this study was to evaluate small-scale farmers' management of sheep-production systems in a selected area of the Eastern Cape Province. This chapter will further discuss the study area, data collection procedures, data analysis, sampling procedure, transfer of results, and ethical considerations.

3.2. STUDY AREA

The study area was the King Sabata Dalindyebo Local Municipality, which is comprised of nine communities – namely, Lower Nqwarha, Upper Nqwarha, Mqanduli, New Rest, Undlunkilu, Uzwelitsha, Maqumeni, Ngcanaseni, and Kugompa. The King Sabata Dalindyebo Local Municipality is in the former Transkei region of the Eastern Cape, South Africa, and is part of the broader O.R. Tambo District Municipality.

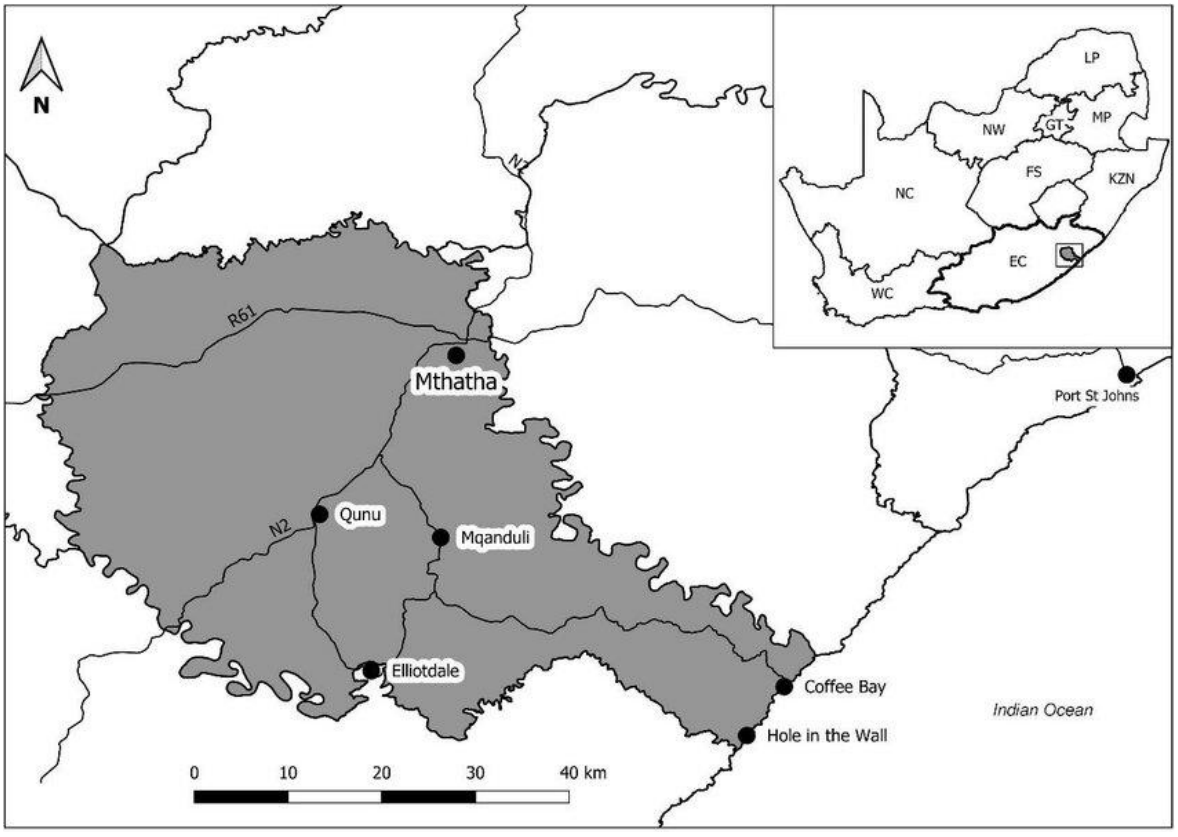

Figure 3.1 The study area: King Sabata Dalindyebo Municipality (31º49'0'' South, 28º45'0'' East) *Source: Giddy et al. (2020)*

The Eastern Cape Province is bordered by Western Cape to the west, Northern Cape to the northwest, Free State Province and Lesotho to the north, KwaZulu-

Natal to the northeast, and the Indian Ocean to the southeast and south, with Bisho being the provincial capital.

The King Sabata Dalindyebo Municipality is largely rural in character, with the urban area concentrated around the town. It is 3,027 km^2 in extent and has a total population of 488,349 (Stats SA, 2016). The major economic activities in the Municipality are forestry and agriculture, although agriculture is of a small subsistence nature. The Municipality is comprised of a range of settlement forms – namely, urban areas, rural settlements, privately owned farms, and small holdings. Neighbouring local municipalities are Nyandeni Local Municipality to the northeast, Mhlontlo Local Municipality to the north, Engcobo Local Municipality to the west, and Mbashe Local Municipality to the south. King Sabata Dalindyebo Municipality has a grassland and thicket biome, which is thought to contain a wide range of species and be rich in formations of woody plants.

Table 3.1 Agricultural households in Kings Sabata Dalindyebo Municipality: Statistics (2016)

Population overall	488,349
Population under the age of 15	35%
Population above 15 year to 45 years	37,2%
Population above 45 years to 65 years	33%
Population above 65 years	5,1%
Population growth per annum	0,18%
Unemployment rate	38,3%
Youth unemployment rate	43,3%
Households in specific agricultural activities	48,405
Livestock	30,6%
Poultry	31,1%
Vegetables	24,8%
Other crops	8,1%

Table **3.1** shows statistics related to agricultural households in King Sabata Dalindyebo Municipality, which has an annual population growth of 0,18%. The Municipality, unfortunately, has one of the highest unemployment rates; agriculture thus plays a vital role for the residents of the Municipality, as agricultural practices are mostly subsistence in nature.

The study area was chosen based on statistics by Stats SA (2016) on the number of households involved in agricultural activities in the area.

3.3. Research Design and Sampling Procedure

The study employed a descriptive cross-sectional survey design to assess the management practices and productivity levels of small-scale sheep farmers. This design enabled data collection at a single point in time to explore associations between farm management variables and production outcomes.

The target population consisted of all small-scale sheep farmers within the KSDLM, defined for this study as farmers owning between 5 and 500 sheep. The population frame was developed in collaboration with local agricultural extension officers and community leaders, who provided access to farmer lists and locations within the municipal wards.

A purposive sampling technique was used to select participants based on the inclusion criteria of active engagement in sheep production and a willingness to participate. The sample size of 147 farmers was determined using the Yamane formula (Yamane, 1967) for finite populations, assuming a 95% confidence level and a 5% margin of error. This sample was deemed adequate to ensure a representative distribution across the municipality's rural wards while maintaining logistical feasibility.

3.4. DATA COLLECTION

A questionnaire was used to collect the data. According to Van Niekerk and Truckman (2002), a questionnaire survey method makes it possible to measure what a person knows and the type of information they possess, their values and beliefs, and their attitudes towards the questionnaire topic. The study made use of personal interviews in order to enable the interviewer to observe behaviour that the questionnaire was not designed to detect. Data collection for this study was conducted over a seven-month period, from April 2023 to October 2023. The study initially aimed to randomly identify and interview 25 or more small-scale farmers. Ultimately, 147 respondents participated.

When conducting a questionnaire survey, administered questionnaires deliver better results (Van Niekerk & Truckman, 2002). The questionnaire survey can be done in

three different ways – namely, personal, telephonic, and mail interviews (Randela, 2005). Information for this study was collected by means of primary data, with a well-constructed questionnaire used to gather the required data. The questionnaires were structured with open- and closed-ended questions, and the information was gathered through personal interviews.

3.5. DATA/STATISTICAL ANALYSIS

Data were cleaned, coded, and captured using Microsoft Excel, then exported to IBM SPSS Statistics Version 27 for analysis. SPSS was selected for its robust capacity to handle large datasets and generate both descriptive and inferential statistical outputs appropriate for agricultural survey data.

Descriptive statistics such as frequencies, means, standard deviations, and percentages were used to summarise respondent profiles and farm characteristics. Spearman's rank-order correlation was employed to examine the relationships between specific management practices (e.g., ewe replacement, supplementary feeding) and production outcomes (e.g., lambing percentage and mortality) due to the ordinal and non-parametric nature of some variables. A significance level of $p < 0.05$ was adopted for all inferential statistical tests.

3.6. DISSEMINATION AND APPLICATION OF RESULTS

The study targeted small-scale farmers who specialise in sheep production in the King Sabata Dalindyebo Local Municipality. The results, as well as recommendations to improve sheep managerial skills and production practices, will be communicated and implemented through agricultural extension officers and communal agricultural leaders.

3.7. ETHICAL CONSIDERATIONS

Ethical considerations to maintain good and healthy relations with the various study groups, government departments, and individuals who provided support and cooperation included application of the following principles:

1. Fairness and justice
2. Autonomy of subjects

3. Doing good
4. Avoiding doing harm

The questionnaire was completely anonymous, thus protecting any confidential information provided by the participants.

4. CHAPTER FOUR: SOCIOECONOMIC CHARACTERISTICS AND FARM RESOURCES OF SMALL-SCALE SHEEP FARMERS IN THE KING SABATA DALINDYEBO LOCAL MUNICIPALITY

4.1. INTRODUCTION

This chapter presents the findings of the survey administered to small-scale sheep farmers in the King Sabata Dalindyebo Local Municipality. The results are presented using descriptive statistic frequencies, counts, charts, percentages, and standard deviations. Respondents were interviewed on their farms, which gave the researcher an opportunity to observe the farming area and practices. The demographic characteristics of the respondents, the breeds that were dominantly used, and the farming experience of the farmers are discussed.

4.2. AGE, GENDER, AND FARMING EXPERIENCE

4.2.1. Age of Respondents

As illustrated by table 4.1 the average age of respondents was 49.16 years (SD ± 13.78), with the majority falling within the middle-aged to older category. Although this demographic suggests a wealth of experience in sheep farming, it also presented noticeable constraints in terms of innovation uptake, response to extension services, and overall adaptability. The study did not conduct a formal statistical analysis linking age directly to production outputs; however, consistent field observations revealed age-related differences in farm management approaches.

Older farmers frequently expressed reluctance to adopt new technologies or modern farming methods, with many citing long-term farming experience as justification for continuing with traditional practices. This reluctance is consistent with findings by Chisango et al. (2022), who noted that age is a significant determinant in smallholder technology adoption across Sub-Saharan Africa, with older farmers showing less engagement in innovation driven practices. Conversely, younger farmers though fewer in number were notably more open to adopting recommended practices such as fertility testing, record-keeping and vaccination practices. Sinyolo and Mudhara (2021), identified similar trends that younger farmers in South Africa were more responsive to extension interventions and more likely to integrate new practices into their farming systems.

While a direct causal relationship cannot be established within the scope of this study, the observed age-related attitudes and behaviours appear to influence farm management efficiency. These findings support the need for age-sensitive extension strategies that bridge generational gap in farming approaches

Table 4.1 Mean ± SD age and farming experience of farmers in the King Sabata Dalindyebo Local Municipality

Municipality	Age (years)	Farming experience
King Sabata Dalindyebo	49.16 ± 13.78	15.91 ± 12.63

4.2.2. Farming Experience

Table 4.1 depicts that the average farming experience among respondents was 15.91 years, suggesting that most farmers had long-term involvement in sheep farming. While this experience might imply a high level of competence, field observation revealed that experience alone did not guarantee efficient farm management or higher productivity.

Notably farmers with over twenty years of experience were less likely to maintain proper records, test rams for fertility, or replace breeding stock regularly, with most continuing to rely on traditional practices with a reluctance to adopt new technologies or scientifically informed management techniques. These findings align with those of Ajayi et al. (2023), who found that while experience can enhance resilience it may also reinforce outdated practices if not complemented by continuous learning and extension engagement. On the other, less experienced farmers especially those under ten years of farming tended to be more receptive to extension advice and showed great willingness to implement improved management practices. Mashamaite et al. (2021), concluded that openness to innovation was often more predictive pf productivity than years of experience alone.

These results suggest that while farming experience provides foundational knowledge, its positive influence depends significantly on access to updated information, training and extension support.

4.2.3. Educational Level

Table **4.2** shows that 7.5% (n = 11) of respondents had an ABET (adult basic education and training) level of education, 15.0% (n = 22) had a primary-level education, 44.6% (n = 66) had a secondary-level education, and 32.7% (n = 48) had a tertiary-level education. This indicates a fairly literate farming population, with most respondents having at least a basic schooling. However, educational levels appeared to significantly influence how respondents engaged farm management activities and extension services.

Farmers with tertiary education were more likely to make informed decision around breeding and marketing. Farmers with lower levels of education generally lack proper documentation and required more support to interpret extension messages. The results suggest that education not only facilitates better decision-making, but also enhance the farmer's ability to interact with and benefit from external support services.

Dlamini et al. (2021) emphasizes that higher educational attainment improves the capacity of smallholder farmers to interpret technical knowledge, market access and response to risk. Adeola and Mabuza (2020), continue to state that education enhances innovation adaption and the efficiency of livestock production systems in rural farming communities.

Table 4.2 Educational level of respondents

Educational level	King Sabata Dalindyebo Local Municipality	Percentage (%)
ABET	11	7,4
Primary	22	14,9
Secondary	66	44,6
Tertiary	48	32,4
Total	147	100

4.2.4. Gender Distribution

Figure 4.1 illustrates the gender distribution of the respondents. In this study, 43% of the total number of respondents (n=147) were female and 57% were male, indicating a moderate female participation in small-scale sheep farming with in the King Sabata Dalindyebo Local Municipality. Female farmers particularly those in the older age

group were observed to perform better than their male counterparts in the application of scientific management practices. In contrast, older male farmers showed a degree of resistance to extension guidance, especially when the service providers were younger. Among younger farmers, both men and women demonstrated high receptivity to innovation and participated actively in extension session. However, across all age groups female respondents consistently showed a higher level of attentiveness, compliance with recommendations, and willingness to collaborate suggesting a stronger alignment with efficiency enhancing practices.

According to Nkosi and Belete (2020), female headed smallholder farms in the Eastern Cape shows greater compliance with livestock health protocols and maintain better hygiene than their males. Additionally, Maponya et al. (2022), states that women often play a central role in livestock-based food systems and when empowered, they contribute significantly to productivity and sustainability.

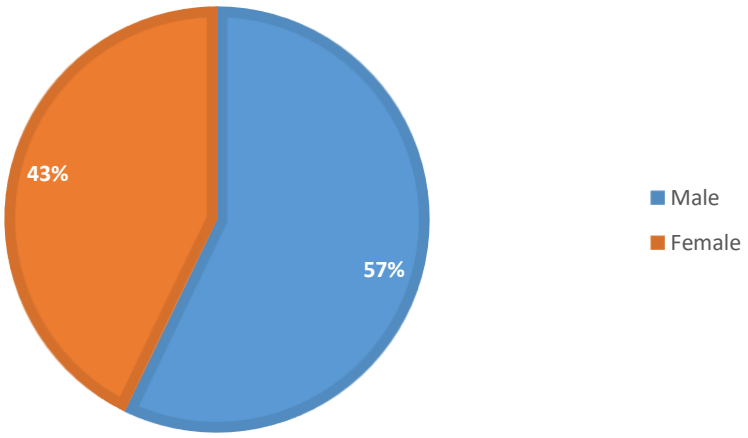

Figure 4.1 Gender of respondents in King Sabata Dalindyebo Local Municipality

4.2.5. Sheep Breeds Respondents are Farming With

From Figure **4.2**, it can be seen that most respondents were farming with Dohne Merinos (n = 83), followed by Merinos (n = 70) and other cross breeds (n = 19), with the lowest number of respondents farming with Meatmaster, Dormer, and Dorper breeds (n = 1, respectively). Farmers indicated that they used the Dohne Merino due to its dual purpose and acclimatisation to the area. South African studies have found

that farming with a suitable dual-purpose breed for a specific climate can generate a higher income than farming with a meat-only breed (Louw, 2016).

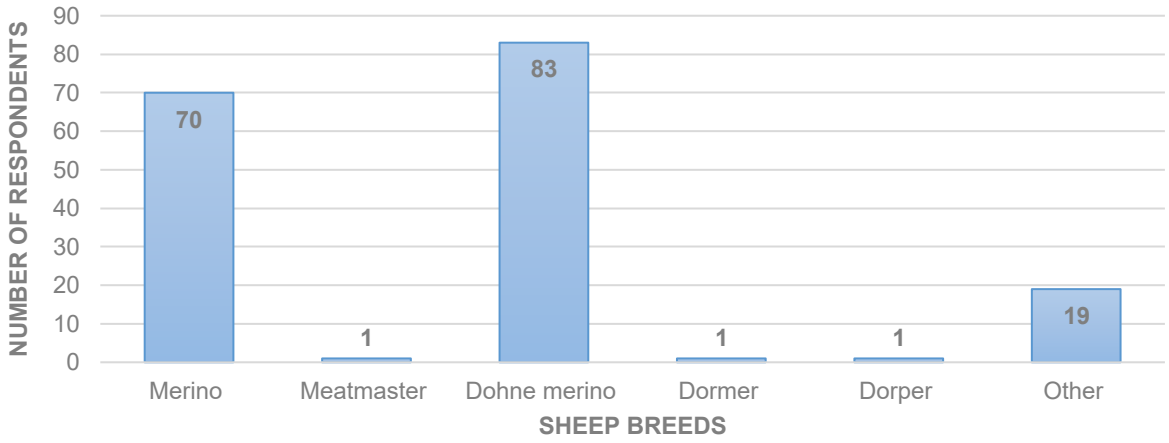

Figure 4.2 Sheep breeds on the assessed farms

4.3. LAND OWNERSHIP

As depicted in table 4.3, most (50.7%) of the farmers in the study farmed on their own land, 40.5% on communal land and only a small percent (4.1%) on leased land. Those who farmed on their own land generally had more control over land use and decision-making, however even among this group infrastructure development remained limited due to financial constraints. Farmers who farmed on communal land faced more pronounced challenges such as grazing competition, limited fencing, and a lack of long-term security, which discouraged infrastructure investment and affected the implementation of rotational grazing or health protocols. Those leasing land raised concerns about short-term access and restriction to improvements.

Hornby et al., (2022) indicates that land insecurity especially in communal systems discourages long-term investment and limits productivity. Cousins and Hall (2020) futher states that secure tenure is essential for improving infrastructure and enabling sustainable livestock systems.

Table 4.3 Land ownership by respondents

Land ownership	King Sabata Dalindyebo Municipality	Percentage (%)
Own	75	50,7
Communal	60	40,5
Lease	6	4,1
Total	141	100

4.4. EQUIPMENT OWNED

Farming equipment is essential for a sheep farmer, as it is required for activities like dosing, dipping, castration, vaccination, and the treatment of sick animals, which should be carried out timeously by the farmer (Makapela, 2009). In this study, one of the many constraints faced by farmers is not owning basic equipment such as a dosing gun, castrating ring applicator, suitable vehicle (e.g., bakkie), syringes, and a scale. Ready availability of such basic equipment plays a significant role in animal production and management. Figure **4.3** indicates the number of farmers who owned a bakkie, a scale, a castrator ring applicator, syringes, and a dosing gun. Most farmers (n = 141; 96%) owned syringes, 61.0% (n = 89) owned a dosing gun, 47.3% (n = 69) owned a bakkie, 39% (n = 57) owned a castrating ring applicator, and 18.5% (n = 27) owned a scale.

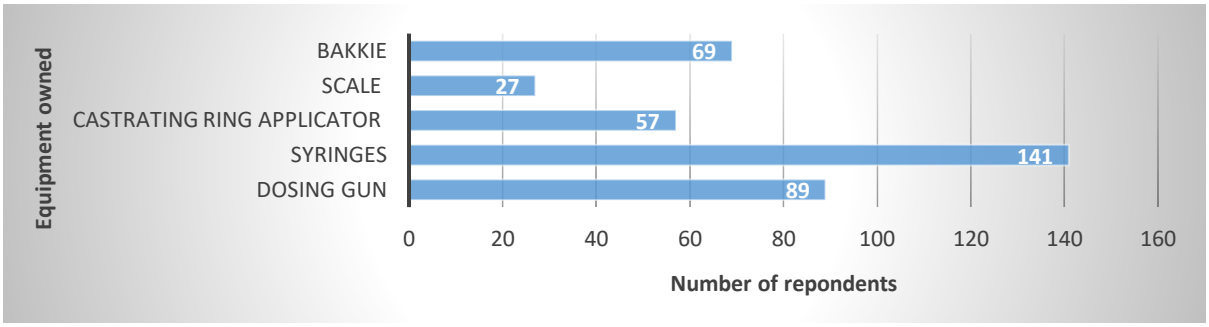

Figure 4.3 Equipment owned by assessed farmers

Education, frequent visits by extension agents to train farmers on how to use equipment and making it possible for smallholders to access and afford agricultural equipment, are important factors for increasing small-scale agricultural production (Owomb *et al*., 2012).

Table **4.4** illustrates the total number of farmers who owned all the basic equipment versus those who only owned one or a few of pieces of the above-mentioned equipment. The results indicate that a lack of farming equipment is one of the challenges experienced by these small-scale farmers.

Owning a dosing gun is very important when it comes to sheep farming, as a dosing gun ensures precise administration of remedies. It allows the farmer to deliver the correct dosage based on the weight of each sheep, minimises under-dosing or overdosing, and saves time. A dosing gun thus maximises efficacy. Properly dosed sheep respond better to treatment, and using the correct equipment ensures that the product works effectively, thereby promoting the health and well-being of your flock. Owning such equipment reduces the risk of injuries to oneself and minimises disease transmission among sheep (Zoetis, 2020).

Table 4.4 Farmers who own all basic equipment and limited basic equipment

Equipment owned	Number of respondents	Percentage (%)
All basic equipment	17	11,5
One or a few pieces of basic equipment	130	88,5
Total	147	100

4.5. FARM INFRUSTRUCTRE

According to Mapiye et al. (2020), inadequate infrastructure remains a key constrains in smallholder livestock systems, affecting both animal welfare and productivity. Table 4.5 below shows the farm infrastructure as recorded during the study. Most (73%) of the farmers had a shed, only 30.4% had a race and all the farmers had a kraal on their farms.

Although the presence of a kraal on the farms indicated a basic level of infrastructure for animal containment, the overall infrastructure for health, breeding and handling operations was insufficient. The limited availability of a race in farms posed challenges for routine management task and ineffectiveness during animal treatment. Therefore the absence of a specialized infrastructure such as a race hindered overall health management of the flock.

Table 4.5 Farm infrastructure as indicated by farmers

Farm infrastructure	Number of respondents	Percentage (%)
Kraal	147	100
Shed	108	73,4
Race	45	30,4

4.6. FARMING INCOME

Agriculture contributes to poverty alleviation at rural, urban, and national level by reducing food prices, creating employment, and increasing income. Thus, the performance of the food-marketing sector is a major determinant in both food costs and farmer income. As indicated in Table **4.6**, only a small number of farmers did not sell their sheep, while a large number (83.8%) sold their livestock. Those farmers who did not sell their livestock for a period between two – three years indicated that it was mainly because of lack of marketing skills and information about viable marketing channels. Some did not see the need to sell, as they had other means of income. The biggest factor in the decision to retain livestock was to maintain their wealth status; it is believed that the more animals you have, the more respectable you will be in the community.

Table 4.6 Number of farmers who market their livestock versus those who choose not to

Do you sell your livestock?	Number of respondents	Percentage (%)
Yes	124	83,8
No	22	14,9
Total	146	98,6

Nagayets (2005) states that the income of smallholder farms is mostly received from the sales of surplus farm produce and topped up by non-farm income. In the South African smallholder context, it has been found that farming income amounts to approximately 40% of total income, while the remainder is derived from non-farm income (Katikati, 2017). According to Mmbengwa *et al*. (2015), the Eastern Cape was found to be one of the provinces that had the highest income-generating capacity from livestock owned by developing farmers, followed by the Northern Cape and the Limpopo Province. Table **4.7** gives an indication of the number of lambs, ewes, and rams sold by study participants in 2022. Farmers sold an average of thirty-one lambs,

fifteen ewes and seven rams. Lamb sales generated the highest income with an average return of R30 007, while ewes and rams brought in R14 019 and R14 898 respectively. The average total income from livestock sales was R60 113, but with a high variation (SD = R61 470) showing that some farmers earn significantly more than others.

This variation in income reflects differences in flock size, market access and information, and pricing. It also highlights that while sheep farming can provide meaningful income, it is often unprotected and seasonal. As Sinyolo (2022) explains, such income instability makes it difficult for small-scale farmers to plan or reinvest in their operations. Structured markets and better pricing support could help farmers improve income reliability and productivity.

Table 4.7 Number and total value of lambs, ewes, and rams sold

	Number of respondent	Minimum	Maximum	Mean	Std. deviation
Total number of Lambs sold	54	2	150	30.78	31.93
Total number of Ewes sold	109	1	75	14.73	11.39
Total number of Rams sold (1 year and older)	74	0	42	7.05	9.034
AVG price per lamb (R)	54	200	2,500	1,136.25	450.28
Total value of lambs sold	54	2,800	165,000	30,007.41	29,339.68
Total value of ewes sold (R)	109	1,300	85,000	14,018.99	12,114.10
Total value of rams sold (R)	72	700	80,500	14,897.78	19,513.71
Total income from livestock sales (R)	147	5,003	333,267	60,113	61,470.12

4.7. THE IMPORTANCE OF WOOL PRODUCTION AMONG SMALL-SCALE FARMERS AND ITS CONTRIBUTION TO FARMING INCOME

Wool farming plays an important role as a main source of livelihood for many small-scale farmers in South Africa (Meissner *et al*., 2013). However, there has been a continuous decline in national wool production over the past three decades, which has become a serious challenge for the South African government (Cape Wools SA, 2019). Ntsiapane *et al*. (2023) argue that the inefficiency among small-scale wool farmers is due to poor extension services and poorly managed farmers' associations.

Ntsiapane *et al*. (2023) reiterate that most small-scale farmers are not producing at full capacity and have much room for improving their wool production. For the purpose of this study, farmers were asked how they market their wool, and 76.4% (n = 126) indicated they sell their wool at BKB while 23.6% (n = 30) sold their wool via an agent (see Table **4.8**).

Table 4.8 Wool markets used by small-scale farmers in King Sabata Dalindyebo

Markets used by farmers	Number of respondents	Percentage (%)
BKB	126	76,4
Agent	39	23,6

Selling of wool by small-scale farmers is traditionally considered to be extra cash income. Wool from small-scale farmers is usually of low quality and is sold to local traders at very low prices or through BKB via farmers' associations. Wool production has been shown to have high potential as a source of cash income that can sustainably contribute to household income, if the quality and quantity of wool production is improved (Haese *et al*., 2001). Wool production can contribute to poverty alleviation and stimulate rural economic growth. A joint initiative between the NWGA, the government, and the Agricultural Research Council (ARC) has the objective to improve the situation of rural households by intensifying agriculture and, in particular, developing small-scale wool production. Small-scale wool production is stimulated by investment in shearing sheds and training in wool sorting, shearing, and other farming practices (Aucamp, 2007).

4.8. SOURCE OF EMPLOYMENT

In this study, 63.5% of the respondents were employing people to work on their farms, while the remaining 35.8% did not employ any workers. Those respondents who were not employing people indicated that it was because they could not afford to pay salaries or they were getting assistance from their family members. According to Moyo *et al*. (2010), livestock production plays a vital role in providing food to urban and rural consumers and in job creation, thus reducing the level of unemployment.

As shown in table 4.9, the assessed farms collectively employed ninety-three permanent workers, with the majority of farms employing one to two workers. Specifically, 52 respondents (35.1%) employed one worker, and (n=17) 11.5% employed two worker, while only a small number had three or more. All employed individuals were employed at a permanent basis, with most originating from local communities or nearby rural villages.

The monthly salary ranged between R600 – R4000, with informal pay structures. Employment was primarily practiced on farms with a large flock size (over eighty animals) and these were farmers who farmed on their own land or had long-term control over communal grazing areas. Overall, the presence of employment opportunities, though limited illustrates the potential role of small-scale sheep farming in local job creation, mostly in rural areas where other forms of employment are scarce

Table 4.9 Number of employed workers on assessed farms

Number of employed workers	Number of respondents	Percentage (%)
1	52	35,1
2	17	11,5
3	8	5,4
4	4	2,7
5	6	4,1
6	2	1,4
7	4	2,7
Total	93	62,8

As of 1 March 2024, the National Minimum Wage in South Africa was increased from R25.42 to R27.58 for each ordinary hour worked (Department of Employment and Labour, 2024). The new minimum wage is also applicable to the vulnerable sector of farm workers, who have, since 2022, been aligned with the National Minimum Wage rate. The National Minimum Wage is the guide according to which an employer is legally required to remunerate employees for the work done. In this study, the mean salary paid by the farmers to their full-time employees was R1,736, which is far below the monthly wage (R4,633.44 per month for a 21-day work month, working 8 hours per day) stipulated by the Department of Employment and Labour.

4.9. CONCLUSION

The study revealed that sheep farming in the King Sabata Dalindyebo Local Municipality is marginally dominated by male farmers, with female farmers also showing great interest in the farming business. The low involvement of youth is of concern, with the average age of a sheep farmer in King Sabata Dalindyebo Local Municipality being 49 years. The small-scale farmers in this study farmed on their own land (n = 75), communal land (n = 60), and leased land (n = 6). Most of the farmers in this area had acquired at least a secondary-level education and farmed with Dohne Merinos, Merinos, and other cross breeds.

Ownership of equipment by farmers in the King Sabata Dalindyebo Local Municipality is of great concern, as the study revealed that only 18% of the farmers owned a dosing gun. The study further indicated that small-scale farmers in this area were struggling with lack of proper infrastructure, which makes it difficult to farm and manage sheep properly.

Wool is one of the by-products that can be marketed for extra income from sheep production. In this study, farmers sold their wool at BKB (76.4%) or via an agent (23.6%).

The study revealed that 63.5% of farmers were employing farm workers, thereby contributing to employment in the King Sabata Dalindyebo Local Municipality. This shows that sheep production plays a significant role in decreasing poverty and contributing to the economic development of rural communities. Most employees that were employed originated from King Sabata Local Municipality, while some came from neighbouring communities. Employee salaries was a troubling aspect that emerged from the study, as the majority of farmers paid their employees much less than the required minimum wage stipulated by the Department of Employment and Labour.

5. CHAPTER FIVE: MANAGEMENT PRACTICES OF SMALL-SCALE FARMERS IN THE KING SABATA DALINDYEBO LOCAL MUNICIPALITY

5.1. INTRODUCTION

In this chapter, the focus is on farm- and flock-management practices. Animal health, nutrition, breeding management, replacement of animals, and record keeping will be discussed. These practices are examined in the context of this study's respondents, who were farmers that farm on their own land, communal land, or leased land.

5.2. FLOCK SEPARATION ACCORDING TO PRODUCTION STAGES

Table **5.1** shows the respondents that were separating their sheep based on their production stages – namely, age and sex. A high number of farmers (n = 113) did not separate the flock according to the animals' stages of production, while only a small number of farmers (n = 34) were dividing their flock according to the stages of production. The biggest constraint that led to farmers not following this practice was a lack of fenced land because their land is in rural communities; thus, it was difficult for them to separate their sheep.

Flock separation by production stages, namely sex and age are an important management practice that enables targeted feeding, health monitoring and breeding control (Mthembu and Mmbengwa, 2021). However, in this study only 23% (n=34) of respondents reported separating their flock according to production stages, while 76.4% (n=113) did not follow this practice (Table 5.2).

Table 5.1 Separation of animals according to their production stage

Separation of animals according to production stage	Number of respondents	Percentage (%)
Yes	34	23,0
No	113	76,4
Total	147	100

The main reason given by respondents for not separating their flocks was due to a lack of fenced camps, particularly among communal land users. Farmers explained that without fencing, it became difficult to isolate specific groups such as pregnant ewes, lactating ewes and weaned lambs. This reflects the broader infrastructure challenge faced in rural small-scale systems. Poor separation of flocks can lead to inbreeding, unplanned mating and nutritional imbalances, which eventually (ultimately) reduce flock performance.

According to Mototi et al. (2022), the ability to manage flock effectively is directly linked to land tenure and infrastructure access. Without these, small-scale farmers are constrained in their ability to adopt best practice, even when they have the knowledge. Therefore, these results suggest that flock separation according to production stages is not commonly practices in this study area, not due to a lack of awareness but rather due to practical limitations such as land access and infrastructure. Addressing these constraints could improve breeding control, reduce lamb mortality, and increase overall productivity.

5.3. ANIMAL REPLACEMENT

5.3.1. Ram Replacement

Table **5.2** shows that 115 respondents (77.7%) replaced rams yearly or every two years; the remaining 32 respondents (21.6%) did not replace rams at all. Farmers who did not replace rams cited lack of awareness and the perception that replacement was unnecessary.

Table 5.2 Farmers who practice ram replacement

Ram replacement	Number of respondents	Percentage (%)
Yes	115	77,7
No	32	21,6
Total	147	99,3

Among the 115 farmers who replaced rams, 33% (n=38) replaced two rams per year, followed by 25.2% (n=29) who replaced one. Smaller proportions replace three

(18.3%) or four rams (9.6%). Only a few farmers ($\leq 2.6\%$) replaced six or more rams annualy. This variation is notable/understandable given that farmers in this study were classified as small-scale if they owned between five to five hundred sheep. Farmers with smaller flocks typically replaced one or two rams, while larger flock owners though fewer replaced higher numbers annually.

Table 5.4 Ram replacement by assessed farmers

Number of respondents	Number of rams replaced in a year	Percentage (%) of respondents
29	1	25,2
38	2	33,0
21	3	18,3
11	4	9.6
5	5	4.3
3	6	2,6
3	7	2.6
1	8	0,9
3	15	2.6
1	20	0,9
115	71	100

Barkley (2019) emphasizes that effective ram replacement should be based on flock size, genetic goals and fertility performance. The results highlight that while the practice of ram replacement exists, strategic guidance and cooperative support structures are needed to help farmers make effective genetic improvements. Encouraging community ram sharing schemes, training on selection criteria, and improving access to quality breeding stock could enhance flock productivity across the study area.

5.3.2. Replacement and management of unproductive ewes

Effective management of ewe productivity is essential for maintaining flock fertility, reducing mortality and ensuring economic viability (Agriculture and Horticulture Development Board, 2023). In this study, farmers were asked how they managed unproductive ewes and whether they practiced regular ewe replacement (Table 5.5)

Table 5.5 Number of farmers who replace ewes

Replace ewes	Number of respondents	Percentage (%)
Yes	52	35,1
No	95	64,2
Total	147	100

The results showed that only 35.1% of farmers (n=52) practiced ewe replacement, while 64.2% (n=95) did not (Table 5.5). Additionally, only 12.2% of respondents culled ewes after one missed lambing, and 27% gave ewes a second chance, while 54.7% did not cull at all (Table 5.6). Farmers stated cultural reasons for keeping ewes, such as the belief that large flocks represented status and wealth. This reluctance to replace or cull aged, and unproductive ewes contributes to inefficiencies. Older ewes with worn teeth, udder problems, and persistent lameness were more likely to remain in flocks, which compromises lamb survival and growth rates. According to the Agriculture and Food Development Authority (2017), proactive ewe replacement based on performance traits is vital for maintaining flock health and farm profitability.

Table 5.6 Measures taken with unproductive ewes

Measures taken by respondents	Number of respondents	Percentage (%)
Cull all ewes first time	18	12,2
No ewes are culled (for the particular year)	8	5,4
Give ewes opportunity to skip once then cull	40	27,0
No action taken (for all sheep regardless of the year)	81	54,7
Total	147	100

Statistical analysis in this study (Table 6.1) showed that farmers who practiced ewe replacement experienced an 8% higher lambing percentage, compared to those who did not replace ewes. For small-scale farmers, economic pressure and limited access to quality replacement stock remains a significant barrier.

McLaren et al. (2020), argue that strategic ewe culling and replacement not only improves reproductive outcomes but also contributes to flock resilience by removing animals with chronic health or fertility problems. The findings suggest that while

knowledge of ewe replacement exit among some farmers, it is not yet widely adopted in the study area.

5.4. ANIMAL HEALTH

5.4.1. External Parasite Control

External parasites significantly affect sheep health and wool quality. Figure 5.1 shows that 44% of the respondents treated their sheep for lice and mites, 35% controlled for ticks, 20% controlled for sheep blowfly, while 1% were unsure which external parasite they were controlling for. The low treatment rate is concerning, particularly for Merion sheep which are highly susceptible to lice and mites.

A recent study conducted by Moyo et al. (2021), highlighted that poor parasite control contributes to skin damage, weight loss and fleece contamination. Furthermore, limited access to dipping facilities and correct treatment protocols remain a barrier for many small-scale farmers (Nqeno and Zindove, 2022).

The results of the study imply that while farmers are aware of external parasite control, methods are not widely or effectively applied. Therefore extension services should prioritise training on external parasite identification and integrated treatment strategies suited to small-scale farming conditions.

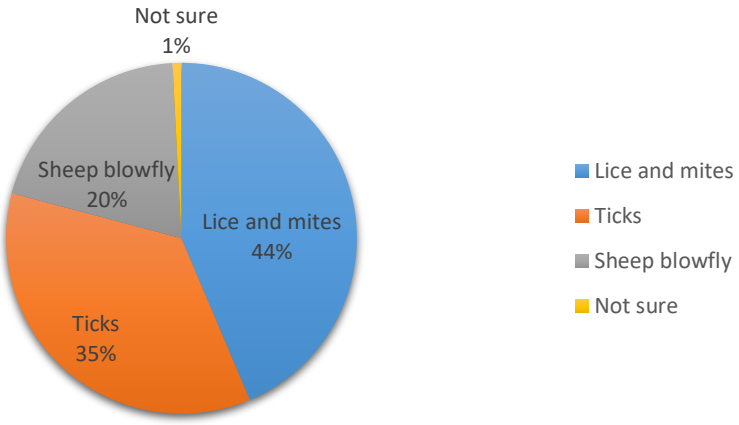

Figure 5.1 External parasites controlled for by respondents

5.4.2. Flock Vaccination

Vaccination is a critical component of disease prevention in sheep production. Farmers were requested to indicate if they vaccinate their sheep and if not, what were their reasons for not vaccinating were. Table 5.7 give an indication of the diseases farmers vaccinated against. In this study, 25.5% of farmers vaccinated against pulpy kidney, 21.2% against sheep scab, and 19.4% against Rift Valley fever. A small number vaccinated for bluetongue (17.8%), Pasteurella (8.6%) and blue udder (7%), while 0.5% were unsure of which diseases their flock had been vaccinated for.

These findings indicate a low uptake of vaccination practices, which may increase vulnerability to preventable diseases. According to Sibanda et al. (2021), poor vaccination coverage in small-scale flocks contribute to lamb mortality and reduces overall productivity. While some farmers reported awareness of vaccines, few had formal guidance on vaccination schedules. Mthethwa and Lekota (2023) emphasize that accessible veterinary support services and farmer trainings are essential to improve vaccine adoption and effectiveness in communal areas.

Table 5.7 Flock vaccination by respondents

Diseases vaccinated for by respondents	Number of respondents	Percentage (%)
Rift Valley fever	86	19,4
Blue udder	31	7,0
Sheen scab	94	21,2
Pulpy kidney	113	25,5
Pasteurella	38	8,6
Blue tongue	79	17,8
Not sure	2	0,5

5.4.3. Major Mortality-Causing Diseases Among Small-Scale Farmers in King Sabata Dalindyebo Local Municipality

As illustrated on Table 5.7 above, farmers were requested to indicate which diseases they vaccinated against. Farmers were asked to identify diseases responsible for mortality on their farms. The most commonly reported disease causing mortality were pulpy kidney (24.9%), Rift Valley fever (23.2%), and bluetongue (18.8) (Table 5.8).

Despite pulpy kidney being the most vaccinated for (25.5%), it remained the top cause for mortality. This suggests issues with vaccine timing, storage or incorrect administration, as noted in related studies (Mthethwa and Lekota, 2023). In addition, lack of information on proper vaccination schedules and the use of incorrect or expired medication was stated by several farmers. A noted portion of farmers (6.1%) reported being unsure of the cause of death, indicating a critical gap in disease identification and record-keeping which is essential for effective veterinary interventions. According to Nengovhela et al. (2022), poor disease control remains a primary constraint in smallholder livestock systems and can be addressed through improved farmer education, early detection practices, and access to veterinary extension services.

There is a need for coordinated farmer training on identification of common disease symptoms, vaccination planning and mortality prevention strategies to reduce preventable deaths and improve flock productivity.

Table 5.8 Mortality-causing diseases

Diseases	Number of respondents	Percentage (%)
Rift Valley fever	68	23,2
Blue udder	17	5,8
Sheep scab	34	11,6
Pulpy kidney	73	24,9
Pasteurella	21	7,2
Blue tongue	55	18,8
Not sure	18	6,1
None	7	2,4

5.4.4. Importance of Dosing Sheep for Effective Production and Productivity Among Small-Scale Farmers

Dosing is a fundamental component of sheep health management, as it controls internal parasites that negatively affect growth, reproduction and wool quality. For the purpose of this study, farmers were asked to indicate how often they dose their sheep in a year. Table 5.9 illustrate that 41.2% of farmers dosed their sheep four times per year, followed by 25% dosing three time, 18.9% dosing twice and 10.2% dosing only once a year. These findings align with Zenda and Malan (2021), who note that regular

anthelmintic dosing is crucial for optimal production and to reduce mortality. However, the frequency and effectiveness of dosing depends on understanding parasite cycles, weather patterns, and flock conditions.

Table 5.9 Number of times farmers dose their sheep in a year

Number of times sheep are dosed in a year	Number of respondents	Percentage (%)
1	15	10,2
2	28	18,9
3	37	25
4	61	41,2
Total	141	95,3

Additionally, farmers were also asked to indicate whether they used ethno-veterinary methods for the purpose of dosing sheep. Table 5.10 indicates that 55.8% of farmers used ethno-veterinary methods such as decoctions from tree bark or aloe, often due to financial limitations. While these remedies are often accessible alternatives, they may lack standardized dosages and proven efficacy compared to commercial treatments (Nqeno and Zindove, 2022). Though farmers are aware of the importance of dosing, more training is needed on strategic parasite control, product rotation and safe integration of traditional and commercial practices.

Table 5.10: Use of ethno-veterinary methods

Do you use ethno-veterinary methods?	Number of respondents	Percentage (%)
Yes	82	55,8
No	65	44,2
Total	147	100

5.5. SUPPLEMENTARY FEED

Farmers were asked to provide information on whether they provided ewes that have lambed with additional supplementary feed and 71.6% (n = 106) of respondents said they provided supplementary feed. The farmers who did not provide supplementary feed to their ewes mentioned that this was due to financial constraints. Table 5.11

shows the number of farmers who gave their ewes supplementary feed and those that did not.

Table 5.11 Farmers who provided supplementary feed to ewes

Provided supplementary feed	Number of respondents	Percentage (%)
Yes	106	71,6
No	40	27,0
Total	146	98,6

Farmers were also asked to indicate the type of supplementary feed provided. The results, illustrated in figure 5.2 below, depicts that 38% (n=43) of respondents provided licks, while 30.7% (n=35) offered feed pallets. A smaller proportion (4.4%) provided chocolate maize.

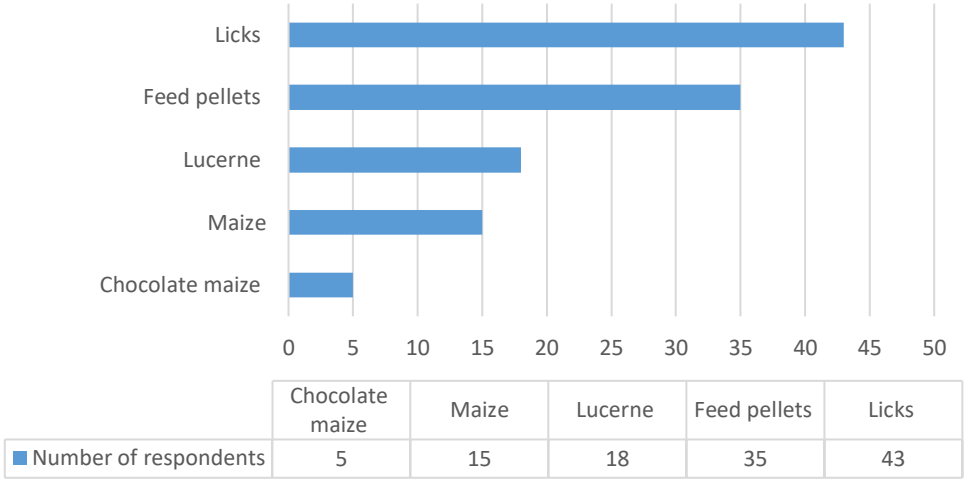

Figure 5.1 Supplementary feed provided by respondents

These figures suggest that while most farmers recognise the importance of supplementation, the diversity and intensity of supplementation remain limited. The low adoption of chocolate maize, despite its proven value in boosting energy during late gestation and early lactation, may be due to cost limitations or limited awareness.

Farmers in the King Sabata Dalindyebo Local Municipality rely primarily on licks and feed pallets as the main source of supplementary feed, with limited provision of other high-energy options. While these supplements are relatively accessible, their effectiveness depends on timing, consistency and alignment with the ewe's nutritional

demands especially during perinatal periods (Barkley, 2019). As highlighted by Motiang et al. (2021), strategic supplementation improves ewe conditions and lamb survival, and as Mkwanazi and Ndlovu (2022) note, licks and feed pallets offer practical value for smallholder systems when used appropriately. Extension support is largely needed to ensure farmers provide supplements effectively across all crucial stages of production.

5.6. BREEDING MANAGEMENT

Breeding management plays a crucial role in flock fertility and genetic improvement in sheep farming systems. In this study, farmers were asked whether they perform fertility test on their rams prior to the breeding season. As shown in table 5.12, only 35.8% (n=53) indicated that they perform such tests, while the remaining 63.5% (n=94) did not. Those who did not mostly citied insufficient knowledge and a shortage of extension and advisory support services as key barriers. This finding aligns with studies in similar small-scale farming systems, where reproductive soundness testing is often overlooked due to poor technical support and limited awareness (Mapiye et al., 2020; Snyman, 2010). The low uptake of fertility testing may partly explain the moderate lambing percentages and relatively high lamb mortality observed in the study area. This suggest that while the practice is recognized by some, it is not yet widely adopted among farmers in the study area.

Table 5.12 Fertility test performance by assessed farmers

Fertility test performed	Frequency	Percentage (%)
Yes	53	35,8%
No	94	63,5%
Total	147	100%

Table 5.13 presents farmer reported figures on production performance for 2021/2022 year. The average flock size was 163.84 and the average number of mature ewes was 103.96 showing significant variation across farms. On average 52 lambs were born alive, while 12 lambs died translating to an average lamb mortality rate of 29.5%, this is a concerning figure especially when linked to the relatively low adoption and

ineffective implementation of health and breeding management practices. This mortality rate (29.46%) is higher than the <20% mortality benchmark suggested for small ruminant systems under good management (FAO, 2018) and indicates substantial productivity losses. The male-to-female ratio had a mean of 1:2.05, with some farms reporting ratios as high as 1:5.56 which is far higher than the recommended 1:20 ratio for optimal flock fertility. This suggests that many farmers keep multiple uncastrated rams in their flock. Though this may reflect cultural beliefs, it can pose management challenges such as inbreeding and uncontrolled mating. It also shows that many farmers do not separate animals by age and sex, a key flock management principle.

The calculated lambing percentage (53.55%) for assessed farms is lower than the expected 80-90% benchmark achievable under well managed extensive systems (Mapiye et al., 2020). However, it is important to note that these calculations were done based on self-reported figures by the farmers and not confirmed through formal mating or pregnancy records. These numbers should therefore be interpreted as indicative trends rather than scientifically confirmed outcomes.

Overall, these results suggest that while some farmers in the King Sabata Dalindyebo Local Municipality have adopted structured breeding practices, such as fertility testing and partial flock management, the majority still lack optimal male-to-female ratios, castration policies, and flock separation strategies, these gaps likely contribute to lamb mortality and suboptimal reproduction. Strengthening extension and advisory services to address these knowledge and practice gaps, particularly around ram management, ewe replacement, and structured mating could substantially improve reproductive efficiency and reduce lamb mortality in small-scale production systems.

Table 5.13 Overall production of assessed farms

Overall production of farms assessed	Number of respondents	Minimum	Maximum	Mean	Std. deviation
Total number of sheep on farm	147	28	780	163,84	112,45
Number of mature ewes	147	18	370	103,96	70,18
Total number of lambs born alive 2021–2022	147	7	280	52,24	47,27

Total number of lambs that died during 2021–2022	147	1	50	12,13	9,23
Male-to-female ratio	147	1,00	5,56	2,05	0,74
Lambing % (based on lambs born per ewe)	147	8,00	136,84	53,55	27,17
Lamb Mortality rate	147	2,27	86,96	29,46	18,69

5.7. SUPPORT SERVICES

Support services are important for improving the efficiency and knowledge of small-scale farmers (Eunice, 2013). In this study area, farmers accessed agricultural information from multiple sources. As illustrated on table 5.14, the majority of farmers (45.8%) indicated that they rely on extension officers for farming advice. This was followed by advice from fellow farmers in the area (23.2%) and a small number of respondents (4.4%) indicated they had a dedicated mentor.

Despite the relatively high percentage of farmers who reported contact with extension officers, several respondents still indicated a lack of consistent extension services as a barrier to adopting improved practices. These findings are congruous with a research by Ngqulana and Obi (2019) who point out that the effectiveness of agricultural extension depends on its level of engagement with farmers. According to Nyam et al. (2022), limited dissemination of agricultural information contributes to poor production outcomes among smallholder farmers. Therefore these services should be more accessible, practical and offered consistently to empower farmers with updated skills and decision-making

Table 5.14 Sources of farming advice

Source of advice	Number of Respondents	Percentage (%)
Agricultural magazine	42	14,1
Television	37	12,5
Farmer in area	69	23,2
Extension officer	136	45,8
Dedicated mentor	13	4,4
Total	297	100,0

5.8. CHALLENGES FACED BY SMALL-SCALE FARMERS

Small-scale farmers in the King Sabata Dalindyebo Local Municipality face multiple challenges that hinder productivity and profitability. Farmers were allowed to mention more than one challenge, as multiple constraints often affect production simultaneously. As shown in table 5.15, the most reported challenge was disease related mortality (74.1%, n=109), some farmers noted that this was largely due to financial constraints, which limited their ability to purchase the correct medicine or access veterinary services. Additionally, a high prevalence of theft (68.7%, n=101) was reported, particularly in communal grazing areas where sheep were more vulnerable due to poor fencing and monitoring.

Drought was reported by 57.8% of farmers (n = 85) as a major production constraint, particularly during dry seasons when grazing resources become limited. Financial constraints were also prevalent (52.3%, n = 77), reducing farmers' capacity to invest in feed, infrastructure, and animal health interventions. Less frequently reported, but still noteworthy, was predation by wild animals (25.9%, n = 38).

According to Munyai (2012), in rural areas financial limitations exacerbate the impact of disease outbreaks, as observed in this study. Theft remains an endemic issue in communal farming zones across South Africa (Afenyo, 2013). The challenges identified in this study area reflect both external (drought, theft, predation) and internal (disease, finances) constraints which displays that there is a need to address these challenges through a multipronged approach involving policy interventions.

Table 5.15 Identified challenges experienced by farmers

Challenges	Number of Respondents	Percentage (%)
Diseases	109	74,1
Theft	101	68,7
Drought	85	57,8
Finances	77	52,3
Predators	38	25,9
Other	1	0,01

5.9. MARKETING PRACTISES AND CHALLENGES

Small-scale farmers in the study area face significant challenges in accessing profitable and reliable markets. As shown in figure 5.3, a high number of farmers (55.3%) sold their animals to private buyers, followed by feedlots (25.6%), abattoirs (11.6%) and auctions (3.5%). These figures reflect a high reliance on informal and semi-formal channels, which often lack price transparency and bargaining power.

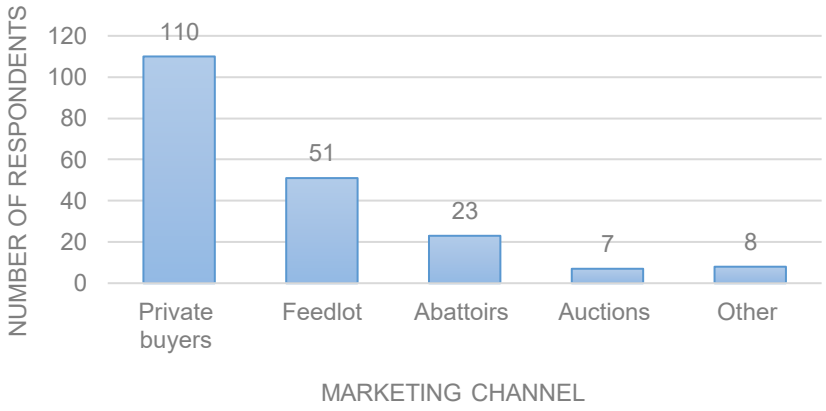

Figure 5.2 Marketing channels

In addition to market access, transportation was identified as a constraint. As shown on figure 5.4, 66% of farmers relied on the buyer's transport, 29% used their own and only 5% hired transport. Dependence on buyer-owned transport puts farmers in a vulnerable position where the buyer dictates both logistic and pricing.

Marketing challenges were therefore found to stem from:

- Lack of access to reliable market information
- Limited extension supporting on marketing
- Lack of own transport

To address these challenges farmers require training on pricing, marketing strategies and better access to formal markets, a study by Ngqulana and Obi (2019) support this statement.

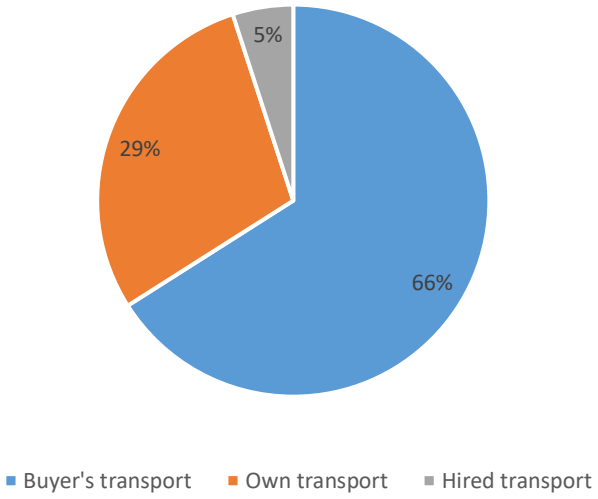

Figure 5.3 Preferred transportation to markets

5.10. CONCLUSION

Farmers are aware of management methods, including the importance of vaccination, controlling for external parasites, the necessity of good nutrition, and general sheep management; nevertheless, execution is still outdated, and there is a significant lack of information. Farmers provided supplementary feed to ewes that have lambed and vaccinated against at least one disease. The disease vaccinated against most frequently was pulpy kidney (25.5%), and this was also the disease that caused the highest mortality on their farms (24.9%). Only 35.8% of farmers performed fertility tests on their rams.

The limited availability of government extension services has had a negative impact on farmer knowledge and capabilities. Extension services play a fundamental role; hence, government needs to implement strategies to bridge this gap. Marketing is an important aspect for farm income and returns. In this study, farmers were marketing their sheep through private buyers (55.5%), feedlots (25.6%), abattoirs (11.6%), and auctions (3.5%). Most farmers (66%) transported their sheep to the market using the buyer's own transport, 29% used their own transport, and only 5% hired transport to deliver their sheep to the market. Support services and other sources of agricultural knowledge are very important for farmer development and information exchange. Farmers relied on a number of sources of information – namely, extension officers (45.8%), a farmer in area (23.2%), and agricultural magazines (14.1%). There were

multiple challenges faced by the farmers, including diseases, theft, drought, finances, predation, and others.

6. CHAPTER SIX: EFFECTS OF VARIOUS MANAGEMENT PRACTICES ON SHEEP PERFORMANCE

6.1. INTRODUCTION

Livestock farming is one of the most viable agricultural activities in South Africa, where approximately 69% of agricultural land is used for extensive grazing on natural veld (DAFF, 2012b). The Eastern Cape Province consists of vast rural areas, and more than 80% of its population is involved in livestock production systems (Braker *et al*., 2002; Perret & Mercoiret, 2003). Livestock farming in communal grazing areas of the Eastern Cape is mostly subsistence in nature and characterised by low inputs. These communal areas are fully integrated mixed units consisting of cattle, sheep, and goats. Farmers generate income from the sale of livestock and their by-products: wool, meat, and dung for fuel or manure, thereby contributing to farm household livelihoods, poverty alleviation, and food security (FAO, 2009). Crop-livestock integration is a means to minimise risk due to crop failures (Kosgey *et al*., 2008).

Despite the importance of livestock husbandry, both at household and national levels productivity within the sheep sub-sector has been quite low in the Eastern Cape Province (Bembridge, 1989). Communal sheep farming is associated with high mortality rates, low reproduction rates, low weaning percentages, and low turnover (Bembridge, 1989). The major underlying causes of low livestock productivity in communal areas include poor housing for animals, poor health resulting from inefficient management practices, and inadequate feed and nutrition (Kusina & Kusina, 1999). However, according to Ajala (2004), the high incidence of diseases is another major constraint associated with small ruminant production.

The following two production variables were investigated in this study: lambing percentage and mortality rate. Management practices investigated were replacement of ewes, provision of supplementary feed, supply of sufficient water, and age at which ewes are mated.

Although some of the management practices discussed in this chapter were introduced earlier, they are revisited here for a distinct purpose. While chapter four focused on the demographic profile of respondents, and chapter five provided descriptive insight into flock and farm management, chapter six represents the

qualitative analysis of how those practices affected sheep production outcomes. The aim is to explore casual patterns and statistical relationships between management decisions and production variables. This structure allows the study to move from observation to evidence, strengthening the validity of the conclusion and ensuring that recommendations are based on measurable effects rather than general trends.

6.2. REPLACEMENT OF EWES

Ewe replacement is a key strategy in flock performance management, especially in smallholder systems where aged or unproductive ewes are often retained due to socio-cultural or economic reasons. Selective culling and replacing of ewes based on health and productivity indicators can reduce lamb mortality and enhance reproductive outcomes (Agricultural and Horticulture Development Board, 2023)

A Mann-Whitney U test was conducted to determine whether there were statistically significant differences in flock performance between farmers who reported replacing ewes and those who did not. The results are shown in Table 6.1 and Table 6.2 below.

The results (Table 6.1) show that farmers who replaced ewes achieved a higher median lambing percentage (58.81%) than those who did not (47.78%) although this difference (Table 6.2) was not statistically significant ($p = 0.268$ and $p = 0.377$). However, a significant difference was observed in mortality rate ($U=1942.50$, $p=0.033$). Farmers who practiced ewe replacement had a lower median mortality rate (20.00%) compared to those who did not (26.09%).

Table 6.1 Differences in dependent variables based on replacement of ewes

	Do you do replacement of ewes?	N	Mean Rank	Median
DEP VAR 2 Lambing %	Yes	52	79,26	58.81
	No	95	71,12	47.78
DEP VAR 4 Mortality rate	Yes	52	63,86	20.00
	No	95	79,55	26.09

These findings suggest that replacing older or less productive ewes may directly improve flock efficiency and reduce lamb deaths likely due to lower risk of birth complications, improved mothering ability, and better general condition of younger breeding stock. These findings are consistent with Dube (2015) and Snyman (2010), who assert that removing ewes beyond their productive lifespan supports lamb survival and reduces mortality-related losses.

Table 6.2: Mann Whitney U statistics and p values based on replacement of ewes

	DEP VAR 2 Lambing %	DEP VAR 4 Mortality Rate
Mann-Whitney U	2196,50	1942,50
Asymp. Sig. (2-tailed)	0,268	0,033

6.3. SUPPLEMENTARY FEED

A major determining factor in the reproductive success of ewes is the relationship between their live body weight, their body shape, and their body condition score (Bath *et al*, 2016). These three factors are closely linked to nutrition, which should be adequate throughout the ewe's reproductive cycle – particularly during critical periods such as just before mating, during mating, and after mating (Snyman, 2010). Furthermore, animals with higher nutrient requirements should be prioritised in supplementation so as to maintain high productivity (Dube, 2015).

6.3.1. Provision of Supplementary Feed

Provision of supplementary feed is a critical management practice, especially during energy-demanding stages. In this study, a Mann-Whitney U test was performed to determine whether farmers who provided supplementary feed to ewes after lambing experienced statistically different flock performance outcomes compared to those who did not.

As shown in Table 6.4, a statistically significant difference was observed in mortality rate between the two groups (U=1384.50, p=0.001). Farmers who provided

supplementary feed had a lower median mortality rate of 20.42%, compared to 33.11% among those who did not. These findings highlight the importance of targeted nutrition for lactating ewes, as it improves energy balances, support milk production and enhances lamb survival. It is particularly important in small-scale systems where grazing alone often fails to meet high post-lambing energy demands (Bath et al., 2016; Dube, 2015).

Table 6.3 Provision of supplementary feed to ewes that have lambed

	Provision of supplementary feed	N	Mean Rank	Median
DEP VAR 2 Lambing %	Yes	106	73,83	54.89
	No	40	72,64	49.51
DEP VAR 4 Mortality rate	Yes	106	66,56	20.42
	No	40	91,89	33.11

Table 6.4: Mann Whitney U statistics and p values based on provision of supplementary feed to ewes after lambing

	DEP VAR 2 Lambing %	DEP VAR 4 Mortality Rate
Mann-Whitney U	2085,50	1384,50
Asymp. Sig. (2-tailed)	0,880	0,001

6.4. SUPPLY OF SUFFICIENT WATER YEAR ROUND

Water is a vital nutrient in livestock production, required for digestion, thermoregulation and metabolic function (Salem and Smith, 2008). In this study a Mann-Whitney U test was conducted to assess whether having a consistent year-round water supply influenced flock performance.

The results shown in Table 6.5 and 6.6, indicate a statistically significant difference in mortality rate between farmers who had a year-round water source and those who had limited access (U=2178.00, p=0.0043). The farmers with sufficient water access had a lower median mortality rate (20.94%), while those without had a higher rate

(28.17%). This supports the findings by the Department of Agriculture and Rural Development [DARD], n.d.), that inadequate water availability, especially during heat stress, increases ewe and lamb mortality due to dehydration and reduced feed intake.

Table 6.5 Provision of sufficient water year round

	Supply of sufficient water year-round	N	Mean Rank	Median
DEP VAR 2 Lambing %	Yes	75	75,31	52.03
	No	72	72,63	48.40
DEP VAR 4 Mortality rate	Yes	75	67,04	20.94
	No	72	81,25	28.17

Results (Table 6.6) indicate that lambing percentage did not differ significantly between groups (p = 0.703). However, mortality rates were significantly lower among farmers with a year-round water supply compared to those without. This finding suggests that, although water availability is critical for survival and overall animal health, its direct influence on reproductive performance may be limited or obscured by other interacting factors such as nutritional status and disease incidence. These results underscore the importance of ensuring continuous access to water as a key management intervention for reducing sheep mortality, particularly in drought-prone regions.

Table 6.6 Effects of water provision on production

	DEP VAR 2 Lambing %	DEP VAR 4 Mortality Rate
Mann-Whitney U	2601,50	2178,00
p-value (2-tailed)	0,703	0,043

6.5. AGE AT WHICH EWES ARE MATED

The age at which an ewe is first mated can influence reproductive efficiency, lamb survival and long-term flock productivity. To assess this, a Spearman's rho correlation was used to determine the relationship between the age of mating and two production indicator: lambing percentage and mortality rate.

As shown in Table 6.7, a positive but non-significant correlation between lambing percentage and age at mating was found (rs=0.146, p=0.092). A statistically significant negative correlation was also found between mortality rate and age at mating (rs=-0,252, p=0.003). This implies that mating ewes at an appropriate age typically around 18 months, reduces lamb deaths. Ewes mated too early may be physiologically immature, while older first-time breeders may experience declining fertility (Snyman, 2010).

Table 6.7 Correlation between dependent variables and age at which ewes are mated

		Age at which ewes are mated (months)
DEP VAR 2 Lambing %	Correlation coefficient	0,146
	p-value (2-tailed)	0,092
	N	134
DEP VAR 4 Mortality rate	Correlation coefficient	-0,252
	p-value (2-tailed)	0,003
	N	134

To further understand farmer practices, respondents were asked to indicate the age at which they typically mate their ewes. The results shown in table 6.8, reveal that 40.7% of farmers reported mating ewes throughout the year, without targeting a specific age or breeding season. This uncontrolled or continuous mating strategy may dilute the benefit of age-specific breeding and complicate the identification of optimal breeding windows. Only 25.9% of respondents reported mating at 18 months, which collates with the age where better performance outcomes were observed. However, a concerning 27.2% reported mating ewes as early as 12 months, which could contribute to higher mortality rates and poorer conception seen in some flocks. There is a clear gap between best practices and current farmer behaviour. A large number of farmers either mate too early or do not control for age at all.

These findings reinforce the importance of proper breeding age selection as part of flock management. Educating farmers in the optimal mating age for ewes could improve reproductive outcomes and reduce lamb deaths, contributing to better productivity in small-scale systems.

Table 6.8: Age at which ewes are mated

Age at which ewes are mated (months)	Number of respondents	Percentage (%) of respondents
12	40	27,2
14	9	6,2
18	38	25,9
All year round	60	40,7
Total	147	100

6.6. CONCLUSION

The findings of this study indicate considerable scope for improvement in production parameters through enhanced management practices. Statistical analyses were conducted on three key dependent variables; lambing percentage, conception rate, and mortality rate. Mortality rate was significantly reduced when supplementary feed was provided to ewes post-lambing, a practice reported by 71.6% of participating farmers. Similarly, the provision of a consistent year-round water supply was associated with lower mortality rates. Furthermore, the age at first mating of ewes demonstrated a statistically significant positive correlation with conception rate. While these results highlight areas of successful management, they also underscore the need for targeted farmer education and training to ensure the correct and consistent application of best production practices, thereby enhancing overall efficiency and productivity.

7. CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The emergent agricultural sector in South Africa holds considerable potential for fostering rural development and mitigating unemployment, poverty, and inequality. However, the participation of small-scale farmers within this sector remains largely underexploited. This study established that sheep farming in the King Sabata Dalindyebo Local Municipality is predominantly conducted by male farmers, most of whom have attained at least secondary-level education. The primary breeds farmed are Merino and Dohne Merino, with breed distribution varying according to the specific community, and a smaller proportion of farmers managing mixed breeds.

Regarding management practices—such as vaccination, internal and external parasite control, provision of supplementary feed, adequate water supply, and general sheep husbandry—most farmers demonstrated awareness. Nevertheless, insufficient practical knowledge and skills impeded the integration of contemporary agricultural techniques into routine management. Reproductive performance was constrained, as evidenced by relatively low conception and lambing rates, alongside mortality rates exceeding expected norms.

Sheep farming contributes to reducing unemployment and alleviating poverty. Small-scale farmers utilize various marketing channels; however, the majority sell their products in informal markets at low prices. The study further revealed a significant deficit in market information among respondents, attributed to limited support from government and extension services. Auction houses could potentially expand their role in educating farmers on product improvement and marketing strategies. Access to market information is essential to enable farmers to make informed decisions regarding marketing channels. These findings underscore the critical role agricultural extension services can play in enhancing management practices through improved dissemination of market information.

Farmers face numerous challenges, including drought, disease prevalence, stock theft, and inadequate infrastructure. Notably, only 61% of farmers owned dosing guns, which are essential for accurate medication administration and maximizing

treatment efficacy; possession of such equipment thus enhances management efficiency and reduces the risk of injury. This underscores the vital role of extension services in supporting small-scale sheep producers by providing training and advisory services. Effective collaboration between the Department of Agriculture, Land Reform, and Rural Development (DALRRD) and agricultural research institutions is necessary to strengthen these support mechanisms.

7.2 Recommendations

- Farm infrastructure, including fencing and livestock handling facilities, should be improved to mitigate high predation rates.
- A strategic and progressive plan for youth engagement in agriculture is recommended, encompassing education and provision of necessary knowledge and resources.
- Government extension services should be actively involved in disseminating both technical and practical knowledge to farmers on a continuous basis. Farmer field schools, as outlined by Braun and Duveskog (2008), offer an effective, hands-on training model that utilizes field conditions as primary teaching tools and are strongly recommended to equip small-scale farmers with current knowledge and technologies.
- Despite the availability of extension services from the DALRRD, Department of Agriculture and Rural Development (DARD), and private sector, a technical knowledge gap persists among small-scale farmers. Extension officers are uniquely positioned to facilitate the practical application of technical information, necessitating frequent and practical training programs tailored to farmers' needs.
- To mitigate drought impacts, farmers should be encouraged to cultivate pastures and establish feed reserves during periods of adequate grazing.
- Training on record keeping, a critical but often neglected management practice, should be prioritized.
- Alternative production financing options should be made accessible through collaboration between Agricultural Extension and Advisory Services and financial

institutions such as commercial banks, Land Bank, the Industrial Development Corporation, and the National Empowerment Fund.

- Farmers should be encouraged to align production with market requirements, including considerations of age, breed, and weight.
- Health and nutrition challenges within flocks should be addressed through participation in agricultural workshops and short courses provided by relevant agricultural institutions.

REFERENCES

Adetayo, A.J. & Eunice, B., 2013. Privatization of agricultural extension services in Nigeria: A fallacy. Asian J. Agric.l Ext., Econ. Sociol. 2(1), 14–22

Adeola, A.M., & Mabuza, M.L. (2020). Education and adoption of improved livestock technologies among rural frmers in Southern Africa. Technology in Society, 63, 101399.

Afenyo, J.S., 2013. Making small-scale farming work in sub-Saharan Africa. https://www.fao.org/fileadmin/user_upload/fsn/docs/Making_Small_Scale_Farming_Work_in_SSA_-_By_Joy_S.__Afenyo.pdf

African Development Bank, 2015. African Development Report 2015. https://www.afdb.org/en/knowledge/publications/african-development-report/ african-development-report-2015/

Agriculture and Food Development Authority, 2017. Breeding ewe lamb replacements. https://www.teagasc.ie/animals/sheep/breeding/ewe-lamb-replacements/

Agriculture and Horticulture Development Board, 2023. Rapid evidence assessment – Castration in lambs. https://ahdb.org.uk/rapid-evidence-assessment-castration-in-lambs

Agriculture and Horticulture Development Board, 2024. Improving the lifetime performance of ewes. https://ahdb.org.uk,improving-the-lifetime-performance-of-ewes

Aina, L.O., 2007. Globalisation and small-scale farming in Africa: What role for information centres? World Libraries and Information Congress, 73rd IFLA General Conference and Council, 19–23 August 2007, Durban, South Africa. https://www.researchgate.net/publication/228870677_Globalisation_and_Small-Scale_Farming_in_Africa_What_role_for_Information_Centres

Ajala, M.K., 2004. Household decision-making in the production of small ruminants in Giwa Local Government Area of Kuduna State of Nigeria. Proceedings of the 29th Annual Conference of the Nigerian Society of Animal Production. pp 399–402.

Ajayi, O.O. Ndaghu, A.A., & Jubrin, A.I. (2023). The paradox of experience: Exploring the role of knowledge and innovation in smallholder livestock production in African. Livestock Research for Rural Development, 35(4).

Aliber, M. & Hall, R., 2010. The case for re-strategizing spending priorities to support small-scale farmers in South Africa. Institute for Poverty, Land and Agrarian Studies (PLAAS) Working Paper 17. https://repository.uwc.ac.za/xmlui/bitstream/handle/10566/4475/wp_17_the_case_restrategising_spending_priorities_support_small_scale_farmers_2010.pdf?sequence=1&isAllowed=y

Allden, W.G., 2001. Feed intake, diet composition and wool growth. University of New England Publishing Unit.

Aucamp, A., 2007. The National Wool Growers Association: Training and technology transfer in communal farming areas. NWGA. https://karoofoundation.co.za/wp-content/uploads/2019/06/Dr_Amie_Aucamp_paper_-_National_Wool_Growers_Training.pdf

Ayyad, M.A., 2003. Case studies in the conservation of biodiversity: Degradation and threats. J. Arid Environ. 54, 165–182.

Barkley, M., 2019. Ram selection principles. Penn State Extension Department.

Baron, V.S., Doce, R.R., Basarab, J. & Dick, C., 2016. Swath grazing oat or grazing stockpiled grass compared to a traditional winter feeding method for beef cows in central Alberta. Can. J. Plant Sci. 96, 1125–1137.

Bath, G.F., Penrith, M. & Leask, R., 2016. A questionnaire survey on diseases and problems affecting sheep and goats in communal farming regions of the Eastern Cape province, South Africa. J. S. Afr. Vet. Assoc. 87(1), e1–e10.

Bembridge, T.J., 1989. Aspects of smallstock production in Ciskei. South Afr. J. Anim. Sci. 19(1), 1–3.

Botlhoko, G.J. & Oladele, O.I., 2013. Factors affecting farmer participation in agricultural projects in Ngaka Modiri Molema District Northwest Province, South Africa. J. Hum. Ecol. 41(3), 201–206.

Braker, M.J.E., Udo, H.M.J., & Webb, E.C., 2002. Impact of intervention objectives in goat production within subsistence farming systems in South Africa. South Afr. J. Anim. Sci. 32, 185–191.

Braun, A. & Duveskog, D., 2008. The Farmer Field School Approach: History, global assessment and success stories. International Fund for Agricultural Development (IFAD) and the Food and Agricultural Organisation (FAO).

Briske, D.D., Derner, J.D., Brown, J.R., Fuhlendorf, S.D., Teague, W.R., Havstad, K.M., Gillen, R.L., Ash, A.J. & Willms, W.D., 2008. Rotational grazing on rangelands: Reconciliation of perception and experimental evidence. Rangel. Ecol. Manag. 61(1), 3–17.

Brown, D. and Miller, D., 2017. Nutritional influences on wool growth and quality: Recent advances. *Small Ruminant Research*, 148, pp.1-9.

Brunsdon, R.V., 1980. Principles of helminth control. Vet. Parasitol. 6(1–3), 185–215.

Cape Wools SA, 2019. Production statistics per area of origin. https:// www.capewools.co.za/documentlibrary/annual-statistics.

Chisango, F.F.T., Antwi, M.A., & Sibanda, M. (2022). Determinants of technology adoption among smallholder farmers in sub-Saharan Africa: A review. *Heliyon, 8*(2), e08921. https://doi.org/10.1016/j.heliyon.2022.e08921

Cronjé, G.J., Du Toit, G.S., Mol, A.J., Van Reenen, M.J. & Motlatla, M.D.C., 1997. Introduction to Business Management (4th ed.). International Thompson Publishing.

Cousins, B., & Hall, R. (2020). Land rights and livelihoods in South Africa: Challenges for pro-poor land reform. Journal of Agrarian Change, 20(3), 462–479.

Dalton, C., 2009. Introduction to practical animal breeding. Blackwell.

Delgado, C.L. & Siamwalla, A., 1997. Rural economy and farm income diversification in developing countries. Markets and Structural Studies Division, International Food Policy Research Institute (IFPRI).

Delgado, C.L., Rosegrant, M., Steinfeld, H., Ehui, S. & Courbois, C., 1999. Livestock to 2020: The next food revolution. Food, Agriculture, and the Environment Discussion Paper 28. FAO.

DAFF [Department of Agriculture, Forestry and Fisheries], 2012a. A profile of the South African mutton market value chain. Government Printers.

DAFF [Department of Agriculture, Forestry and Fisheries], 2012b. A framework for the development of smallholder farmers through cooperatives development. Government Printers.

DAFF [Department of Agriculture, Forestry and Fisheries], 2014. A South African wool value chain profile. Government Printers.

DARD [Department of Agriculture and Rural Development], No date. Water requirements of Livestock. KZNDARD. https://www.kzndard.gov.za/images/Documents/RESOURCE_CENTRE/GUIDELINE_DOCUMENTS/PRODUCTION_GUIDELINES/Beef_Production/Water%20Requirements%20of%20Livestock.pdf

DBSA [Development Bank Of Southern Africa], 1986. Policy guidelines in respect of farmer support programmes. DBSA.

Department of Employment and Labour, 2024. National minimum wage announcement. https://www.gov.za/new/media-statement/government-activities/Minister-thulas-nxesi-announces-national-minimum-wage

Dlamini, M., Sinyolo, S., & Mudhara, M. (2021). The role of education in smallholder agricultural development: Evidence from KwaZulu-Natal. South African Journal of Agricultural Extension, 49(2), 34–46.

DPIRD [Department of Primary Industries and Regional Development], 2021. Agriculture and food. www.agric.wa.gov.au/feeding-nutrition/supplementary-feeding-and-feed-budgeting-sheep

Dube, K., 2015. Characterisation of goat production systems in selected coastal areas of the Eastern Cape Province, South Africa. Master's thesis, University of Fort Hare, South Africa.

FAO [Food and Agriculture Organization], 2005. Country pasture/forage resource profiles – South Africa. http://www.fao.org/ag/AGP/AGPC/doc/counprof/southafrica/southafrica.htm

FAO [Food and Agriculture Organization], 2009. Importance of the livestock sector. Livestock keepers – guardians of biodiversity. https://www.fao.org/docrep/fao/012/i1034e/i1034e02.pdf

Fungo, E., Krygsman, S. & Nel, H., 2017. The role of road infrastructure in agricultural production. Paper presented at the 36th Annual Southern African Transport Conference, 10–13 July 2017, Pretoria, South Africa.

Galal, E.S.E., 1983. Sheep germplasm in Ethiopia. UNEP/FAO Animal Genetic Resources Newsletter 1. 4–12.

Gebremedhin, B., Hoekstra, D. & Jemaneh, S., 2007. Heading towards commercialization? The case of live animal marketing in Ethiopia. Improving Productivity and Market Success (IPMS) of Ethiopian farmers project, International Livestock Research Institute (ILRI). https://www.researchgate.net/publication/228819223_Heading_towards_commercialization_The_case_of_live_animal_marketing_in_Ethiopia

Giddy, J., Rogerson, J. & Idahosa, L., 2020. Final Report: Leveraging state-owned tourism assets for black small, medium and micro enterprises development: A case of state-owned parks, lodges and attractions - phase two (2). Department of Tourism, Republic of South Africa. https://www.researchgate.net/publication/365925736_Leveraging_State-owned_tourism_assets_for_black_Small_Medium_and_Micro_Enterprises_development_a_case_of_state-owned_parks_lodges_and_attractions_-phase_two_2

Gipson, T.A., Merkel, R.C. & Yami, A., 2007. Selecting breeding stock for sheep production. http://www.esgpip.org/PDF/Technical%20bulletin%20No.%204.pdf

Goldblatt, A., 2013. Agriculture: Facts & trends. South Africa. http://awsassets.wwf.org.za/downloads/facts_brochure_mockup_04_b.pdf

Government Communications South Africa, 2013. Pocket guide to South Africa 2012/2013. Government Communication and Information System (GCIS). http://www.gcis.gov.za/content/resourcecentre/sa-info/pocket-guide-south-africa-20122013

Greenberg, S., 2010. Status report on land and agricultural policy in South Africa, 2010. Institute for Poverty, Land and Agrarian Studies, University of the Western Cape.

Greiner, S.P., 2009. Sheep management schedule. Virginia Cooperative Extension Publication 410-365. http://pubs.ext.vt.edu/410/410-365/410-365.pdf

Haese, M.D., Calus, M., Kirsten, J.F., Van Huylenbroeck, G. & Bostyn, F., 2001. Efficiency analysis of small-scale wool production in the former Transkei, South Africa. Agrekon, 40, 641–655.

Hemito, D., 2009. Management for proper range use. Technical Bulletin No. 25. http://www.esgpip.org/PDF/technical%20bulletin%20no.25.pdf

Hofmeyr, J.H., 1976. Breeding policies and progress in relation to wool and meat production in the Republic of South Africa. Proc. Aust. Soc. Anim. Prod. 11, 517–525.

Hornby, D., Kingwill, R., Royston, L., & Cousins, B. (2022). Insecure land rights in communal areas: Impacts on agricultural investment and rural development. Institute for Poverty, Land and Agrarian Studies.

HCCMPW [Hybu Cig Cymru Meat Promotion Wales], 2004. Practical sheep breeding. http://hccmpw.org.uk/medialibrary/publications/Practical%20Sheep%20Breeding%20E.pdf

IPCC [Intergovernmental Panel On Climate Change], 2007. AR4 Climate Change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Johnson, M.H., 2007. Essential reproduction (7th ed.). Wiley.

Jones, A.K., Jones, D.L., Edwards-Jones, G., & Cross, P.J., 2013. Informing decision making in agricultural greenhouse gas mitigation policy: A Best-Worst Scaling survey of expert and farmer opinion in the sheep industry. Environ. Sci. Policy 29, 46–56.

Joubert, R., 2013. The skills needed to make SA farming more profitable. Farmer's Weekly, 16 August 2013. https://www.farmersweekly.co.za/agri-business/agribusinesses/the- skills-needed-to-make-sa-farming-more-profitable/

Kafi, M., Mirzadeh, K., & Ahmadpour, A., 2018. Advances in reproductive management of sheep: A review. *Small Ruminant Research*, 163, pp.1-9.

Katikati, A., 2017. Assessment of production practices of emerging cattle farmers in the selected districts of the Eastern Cape Province, South Africa. Master's thesis, Central University of Technology, South Africa.

Khanvilkar, A.V., Shejal, M.A. & Rahane, S., 2009. Breeding practices in sheep farming. https://www.researchgate.net/publication/49607955_Breeding_Practices_in_Sheep_Farming

Khapayi, M.I. & Celliers, P.R., 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape province, South Africa. S Afr. Jnl. Agric. Ext. 44(1), 25–41.

Kilgour, R.J., Waterhouse, T., Dwyer, C.M. & Ivanov, I.D., 2008. Farming systems for sheep production and their effect on welfare. In C.M. Dwyer (ed.), The Welfare of Sheep. Springer. pp. 213–265.

Kirsten, J. & Van Zyl, J., 1998. Definition of small-scale farmers in the South African context. Agrikon 38, 560–571.

Kleinbooi, G. 2010. Wool industry challenges and opportunities. Merino Focus 2011, 40–42.

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 Rum. Res. 77, 13–28.

Kruger, A.C. & Shongwe, S., 2004. Temperature trends in South Africa: 1960–2003. Int. J. Climatol. 24(15), 1929–1945.

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

Kyriazakis, I., Tolkamp, B.J., and Emmans, G.C., 2018. The relationship between nutrition and wool growth in sheep: A review. *Animal Feed Science and Technology*, 235, pp.54-67.

Lesoli, M., 2008. Communal area grazing strategies: Institutions and traditional practices. Afr. J. Range Forage Sci. 25(2), 47–54.

Levia, D.F., 1999. Land degradation: Why is it continuing? Ambio 28(2), 200–201.

Lohmann, D., Falk, T., Geissler, K., Blaum, N. & Jeltsch, F., 2014. Determinants of Livestock to 2020: The next food revolution. Food, Agriculture and the Environment Discussion Paper 28. FAO.

Louw, A., Chikazunga, D., Jordan, J. & Bienabe, E., 2007. Regoverning markets: Small-scale producers in modern agrifood markets. Agrifood Sector Series – Restructuring food markets in South Africa: Dynamics within the context of the tomato sub-sector. University of Pretoria.

Louw, M., 2016. Dual purpose sheep breeds in South Africa. https://southafrica.co.za/dual-purpose-sheep-breeds-south-africa.html

Lubambo P.T., 2011. An appraisal of post-transfer production trends of selected land reform projects in the North-West Province. Master's thesis, University of Pretoria, South Africa.

Ma, K., Zhang, Z., Liu, C., Chen, W., and Yu, S., 2020. Habitat quality assessment and changes under anthropogenic impacts in a rapidly urbanizing region. *Ecological Indicators*, 112, 106120.

Mahlako, S.R., 2018. Assessment of the management practices of emerging sheep production systems in the Eastern Free State, South Africa. South Afr. J. Agr. Ex 46(2), 57–68.

Makapela, J., 2009. An overview of the management practices for wool production amongst the communal farmers of the HEWU District in the Eastern Cape Province. Master's thesis, Nelson Mandela Metropolitan University, South Africa.

Mapiye, C., Chikwanha, O.C., & Dzama, K. (2020). Infrastructure gaps in smallholder livestock farming systems: Implications for animal health and productivity. Tropical Animal Health and Production, 52(1), 47–58.

Makhura, T.M., 2001. Overcoming transaction costs barriers to market participation of smallholder farmers in the Northern Province of South Africa. PhD thesis, University of Pretoria, South Africa.

Mangisoni, J., 2006. Markets, institutions and agricultural performance in Africa. ATPS Special Paper Series No. 27. African Technology Policy Studies Network.

Mashamaite, L.V., Aliber, M., & Ngcamphalala, T. (2021). Understanding constraints to improved smallholder livestock production: The role of mindset and motivation. South African Journal of Agricultural Extension, 49(1), 26–39.

Matoti, N., Dube, K., & Mahlangu, S. (2022). Infrastructure and land use as limiting factors in smallholder livestock systems. African Journal of Range & Forage Science, 39(1), 18–26.

Maponya, P. & Mpandeli, S., 2012. Climate change and agricultural production in South Africa: Impacts and adaptation options. J. Agric. Sci. 4, 48–60.

Maponya, P. Modise, D.M.,Baloyi, T. (2022). . Women's contribution to sustainable rural livestock production: Policy gaps and empowerment prospects. South African Journal of Agricultural Extension. 50(1):91-102.

Maree, C. & Casey, N.H., 1993. Livestock production systems. Agri-Development Foundation.

Mashala, P., 2014. Communal farming under threat. Farmer's Weekly: Rural insight, 20 March 2014. https://www.farmersweekly.co.za/rural-insight/communal-farming-under-threat/

Matsane, S.H. & Oyekale, A.S., 2014. Factors affecting marketing of vegetables among small-scale farmers in Mahikeng Local Municipality, Northwest Province, South Africa. Mediterr. J. Soc. Sci. 5(20), 390–396.

Mbatha, K.T., and Muchenje, V., 2021. Consumer Preferences and Market Trends for Sheep Meat in South Africa: A Review. *South African Journal of Animal Science*, 51(5), pp. 654–668.

Mcgranahan, D.A. & Kirkman, K.P., 2013. Multifunctional rangeland in Southern Africa: Managing for production, conservation, and resilience with fire and grazing. Land 2, 176–193.

Mclaren, A., Mchugh, N., Lambe, N.R., Pabiou, T., Wall, E., & Boman, I.A., 2020. Factors affecting ewe longevity on sheep farms in the European countries. Small Rumin. Res. 189, 106146.

Meissner, H.H., Scholtz, M.M. & Palmer, A., 2013. Sustainability of the South African livestock sector towards 2050. Part 1: Worth and impact of the sector. S. Afr. J. of Anim. Sci. 43(3), 282–297.

Meissner, H.H., Scholtz, M.M. & Palmer, A., 2020.Evaluating rotational grazing strategies for beef and small ruminants in the Sourish Mixed Bushveld. S. Afr. J. of Anim. Sci. 43(3), 282–297.

Mmbengwa V., Nyhodo, B., Myeki, L., Ngethu, X. & Van Schalkwyk, H., 2015. Communal livestock farming in South Africa: Does this farming system create jobs for poverty stricken rural areas? SYLWAN 159(10), 176–192.

Moran, C., 2014. Preparing for the breeding season on sheep farms. http:// www.agriland.ie/farming-news/preparing-breeding-season-sheep-farms/

Mofokeng, T. & Seerane, J., 2022. Profit efficiency in family-owned crop farms in Eastern Cape Province of South Africa: a translog profit function approach. Agriculture & Food Security, 11(20).

Montanarella, L., Scholes, R. and Brainich, A., 2016. The IPBES assessment report on land degradation and restoration. *IPBES Secretariat*, Bonn, Germany.

Moyo, S., Swanepoel, F., & Stroebel, A., 2010. The role of livestock in developing communities: Enhancing multi- functionality. University of the Free State (UFS) and The Technical Centre for Agricultural and Rural Cooperation (CTA).

Moyo, B., Masika, P.J., & Mapiye, C. (2021). Impact of ectoparasites on small ruminant productivity in Southern Africa. *Tropical Animal Health and Production*, 53(1), 120.

Moyo, N.A., Mapiye, C. & Chimonyo, M., 2021. Role of animal nutritionists in improving livestock productivity in resource-poor farming systems. Animal Feed Science and Technology, 275, 114877.

Moyo, N., Mapfumo, P., & Jaja, T., 2017. Water management and quality in small ruminant production systems: Implications for animal health and productivity. Journal of Agricultural Science and Technology, 19(3), pp.659-671.

Mthembu L.M., 2013. Sustainability of commercial and communal rangeland systems in Southern Africa. Proceedings of the 6th International Rangeland Congress, 17–23 July, Townsville, Australia.

Mthembu, N., & Mmbengwa, V. (2021). Flock management practices and their effects on sheep productivity in *South Africa*. South African Journal of Agricultural Extension, 49(2), 33–45.

Mthethwa, V., & Lekota, T. (2023). Improving vaccine uptake among communal sheep farmers: A case for veterinary extension. South African Journal of Agricultural Extension, 51(1), 25–33.

Mthi, S., Nyangiwe, N., Menhas, R., Mushunje, A., & Ighodaro, I.D., 2018. Women's participation in livestock activities under small-scale farming system in the Eastern Cape Province of South Africa. Department of Agricultural Economics, Faculty of Science and Agriculture, University of Fort Hare, South Africa.

Mullen, G.R. & Durden, L.A., 2018. Medical and veterinary entomology (3rd ed.). Elsevier.

Munyai, F.R., 2012. An evaluation of socio-economic and biophysical aspects of small-scale livestock systems based on a case study from Limpopo Province: Muduluni Village. PhD thesis, University of the Free State, South Africa.

Mushonga, B., Mavangira, V., Muchenje, V. & Dzama, K., 2018. Nutritional management of small ruminants in southern Africa: Challenges and opportunities. *Small Ruminant Research*, 165, pp.1-9.

Nagayets, O., 2005. Small farms: Current status and key trends. In IFPRI, The future of small farms: Proceedings of a research workshop. IFPRI / ODI. p. 355–367.

NWGA [National Wool Growers Association], 2012. National Wool Growers Association (NWGA) Report for the period 1 July 2011 – 30 June 2013. NWGA.

Ndoro, J.T., Mudhara, M., & Chimonyo M., 2014. Livestock extension programmes participation and impact on smallholder cattle productivity in KwaZulu-Natal: A propensity score matching approach, S. Afr. J. Agric. Ext. 42(2), 62–80.

Nel, C., Van Pletzen, H. & Groenewald, I., 2010. Skaapproduksie op meerjarige besproeide weidings. http://www.landbou.com/wp-content/uploads/2014/03/2301eb7c-01b4-4321-b236-e806f79d2ffa.pdf

Nengovhela, R., Tshuma, M., & Zulu, D. (2022). Common causes of small-stock mortality in communal areas of South Africa. *Tropical Animal Health and Production*, 54(7), 505.

Nqeno, N., & Zindove, T.J. (2022). Challenges in sheep health management under smallholder systems. South African Journal of Animal Science, 52(2), 145–152.

Ngqulana, A. & Obi, A., 2019. The impact of extension intensities on income of sheep producers in the Eastern Cape Province of South Africa. Department of Agricultural Economics and Extension, University of Fort Hare.

Nnenna, A. & Obadike, A., 2011. Rural farmers' problems accessing agricultural information: A case study of Nsukka Local Government Area of Enugu State, Nigeria. Libr. Philos. Pract. 20(1), 40–43.

Nordblom, J.L. & Shomo, F., 1995. Food and feed prospects to 2020 in the West Asia North Africa Region. ICARDA Social Science Paper No. 2. International Centre for Agricultural Research in the Dry Areas.

Nordquist, R.E., Van Der Staay, F.J., Van Eerdenburg, F.J., Velkers, F.C., Fijn, L. & Arndt, S.S., 2013. mutilating procedures, management practices, and housing conditions that may affect the welfare of farm animals: Implications for welfare research. Animals (Basel) 7(2), 12.

Nthakheni, N.D., 2006. A livestock production system study amongst resource poor livestock owners in Vhembe District of Limpopo Province. PhD thesis, University of the Free State, South Africa.

Ntshepe, L., 2011. Marketing information needs of smallholder livestock farmers in the Moretele Area in the Bojanala Platinum District Municipality of the North West Province. Master's thesis, University of South Africa, South Africa.

Ntsiapane, A.D., Swanepoel, J.W., Nesamvuni, A.E. & Ojo, T.O., 2023. Assessing the efficiency of smallholder wool farmers in the changing paradigms of the Free State Province of South Africa. Department for Sustainable Food Systems and Development, University of Free State, South Africa.

Nyam, S., 2017. A metafrontier analysis of sheep production in the N8 development corridor. Master's thesis, University of the Free State, South Africa.

Nyam, Y.S., Bahta, Y.T., Oduniyi, O.S. & Matthews, N., 2022. Smallholder sheep farmer's perception of production constraints and competitiveness strategies in South Africa. Sci. Afr. 16, e01192.

Obidike, N.A., 2011. Rural farmers' problems accessing agricultural information: A case study of Nsukka Local Government Area of Enugu State, Nigeria. Library Philosophy and Practice 660, 1–12. https://core.ac.uk/download/pdf/188078327.pdf

Odo, B.I., 2003. Comparative study of some prevalent diseases of ecotype goats reared in South Eastern Nigeria. Small Rum. Res. 50, 203–207.

Oduro-Ofori, E., Aboagye, A. & Acquaye, N., 2014. Effects of education on the agricultural productivity of farmers in the Offinso Municipality. Int. J. Dev. Res. 4(9), 1951–1960.

Owombo, P.T., Akinola, A.A., Ayodele, O.O. & Koledoye, G.F., 2012. Economic impact of agricultural mechanization adoption: Evidence from maize farmers in Ondo State, Nigeria. J. Agric. Biodivers. Res. 1(2), 25–32.

Palmer, A.R., Ainslie, A.M. & Hoffman, M.T., 1999. Sustainability of commercial and communal rangeland systems in southern Africa. Proceedings of the 6th International Rangeland Congress, 17–23 July, Townsville, Australia.

Pålsson, A.M., 1996. Does the degree of relative risk aversion vary with household characteristics? J. Econ. Psychol. 17, 771–787.

Perret, S.R., Mercoiret, M.R., 2003. Supporting small-scale farmers and rural organisations: Learning from experience in West Africa. A handbook for development operators and local managers. Protea.

Poggenpoel, D.G. & Van Der Merwe, C.A., 1987. Selection response with index selection in three commercial Merino flocks. S. Afr. J. Sci. 17, 70.

Prinsloo, L., 2015. Boer goat mini farm. Grootfontein College of Agriculture.

Radostits, O.M., Gay, C.C., Hinchcliff, K.W. and Constable, P.D., 2017. *Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats*. 11th edition. Elsevier.

Randela, R., 2005. Integration of emerging cotton farmers into the commercial agricultural economy. PhD thesis, University of the Free State, South Africa.

Raphela, M.G., 2014. Smallholder farmers in Ekurhuleni: The challenges and constraints of access to agricultural markets. Master's thesis, Stellenbosch University, South Africa.

Ricketts, D., 1993. Restorative dentistry: Management of the deep carious lesion and the vital pulp dentine complex. Br. Dent. J. 191, 606–610.

Rust, J.M., Ndou, P. & Mugabe, F., 2022. Reproductive dynamics and production efficiency among communal sheep flocks in the Eastern Cape Province: A comparative study. *South African Journal of Agricultural Sciences*, 60(4), pp.123–135.

Sachse, J.M., 2012. Sheep production and management: Influence of sire breed, protein supplementation and gender on wool spinning fineness in first-cross Merino Lamb. Int. J. Bio., Biomolec. Agric. Food Biotechnol. Eng. 6(7), 460–467.

Salem, H. & Smith, T., 2008. Feeding strategies to increase small ruminant production in dry environments. Small Rumin. Res. 77, 174–194.

Samuels, I., Jacobs, L. and Dube, Z., 2021. Sustainable water access and rural land reform: A case of post-settlement farms in South Africa. *Sustainability*, 13(7), p.2582.

Saskatchewan Ministry Of Agriculture, 2008. Grazing management for sheep production. https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/livestock/cattle-poultry-and-other-livestock/sheep-and-goats/grazing-management-for-sheep-production

Schoenian, S., 2011. A beginner's guide to raising sheep. http://www.sheep101.info/201/

Sibanda, M., Manyawu, G., & Chikumba, N. (2021). Vaccination practices and their effects on smallholder sheep productivity. Tropical Animal Health and Production, 53(4), 460.

Sikwela, M.M., 2013. The impact of farmer support programmes on market access of smallholder farmers in the Eastern Cape and Kwazulu-Natal Provinces, South Africa. PhD thesis, University of Fort Hare, South Africa.

Sinyolo, S., & Mudhara, M. (2021). Farmer typologies and technology adoption in South African rural agriculture. *Sustainability*, 13(4), 2019.

Sinyolo, S. (2022). Economic vulnerability and livestock income among rural farmers in South Africa. Sustainability, 14(3), 1559.

Smet, M. & Ward, D., 2006. Soil quality gradients around water points under different management systems in a semi-arid savannah, South Africa. J. Arid Environ. 64, 251–269.

Smith, B., 2006. The farming handbook. University of Kwazulu-Natal Press.

Smith, J., Sones, K., Grace, D., Macmillan, S., Tarawali, S. & Herrero, M., 2013. Beyond meat, milk and eggs: Role of livestock in food and nutrition security. Anim. Front. 3(1), 1–8.

Snyman, H.A., 1998. Dynamics and sustainable utilization of rangeland ecosystems in arid and semi-arid climates of South Africa. J. Arid Environ. 39, 645–666.

Snyman H.A., 2010. Longevity of grass seeds in a semi-arid grass land. Grassroots 10(2), 8–15.

Sollenberger, L.E., Vendramini, J.M.B. & Newman, Y.C., 2009. Grazing management concepts and practices. University of Florida.

Stats SA [Statistics South Africa], 2011. Census 2011: Agricultural households. Stats SA.

Stats SA [Statistics South Africa], 2016. Community survey: Agricultural households. Stats SA.

Stehman, S. & Smith, M., 2004. Goat parasites: Management and control. http://goatdocs.ansci.cornell.edu/Resource/GoatArticles/GoatsHealth/Goatparasites/Parasites-SM.pdf

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & De Haan, C., 2006. Livestock's long shadow: Environmental issues and options. FAO.

Steyn, J.J., 1999. Reproduction and AI in small livestock. Taurus Livestock Improvements Cooperative Limited. Perkor Printers.

Sundquist, C.R., 2003. General aspects of modelling and its application in livestock production. In S. Korver & J.A.M van Arendonk (eds), Modelling livestock production systems. Kluwer Academic Publishers. pp. 3–9.

Swanepoel, F.J.C. & Moyo, S., 2010. Multifunctionality of livestock in developing communities. In F.J.C. Swanepoel, A. Stroebel & S. Moyo (eds), The role of livestock in developing communities: Enhancing multi-functionality. CTA. pp. 87–100.

Thomas, K., 2012. Management strategies for a profitable and competitive sheep production system. Animal and Dairy Sciences, University of Wisconsin Madison.

Thompson, J., 2006. Sheep production guide. Oregon State University. https://extension.oregonstate.edu/catalog/pub/em-8916-sheep-production-guide

Taylor, M.A., 2012. Emerging parasitic diseases of sheep. Vet. Parasitol. 189(1), 2–7.

Uchezuba, I.D., Moshabele, E., & Digopo, D., 2009. Logistical estimation of the probability of mainstream market participation among small-scale livestock farmers: A case study of the Northern Cape Province. Agrekon 48(2), 171–183.

Van Der Westhuizen, H.C., Snyman, H.A. & Fouché, H.J., 2005. A degradation gradient for the assessment of rangeland condition of a semi-arid sourveld in Southern Africa. Afr. J. Range Forage Sci. 22, 47–58.

Van der Westhuizen, C. & Mbatha, L., 2018. Effective management practices for smallholder livestock enterprises in South Africa: A case study. South African Journal of Agricultural Extension, 46(2), pp.25–38.

Van Der Zijpp, A., Wilke, P. & Carsan, S., 2010. Sustainable livestock intensification. In F.J.C. Swanepoel, A. Stroebel & S. Moyo (eds), The role of livestock in developing communities: Enhancing multi-functionality. CTA. p. 123.

Van Niekerk, P.D.P. & Truckman, N., 2002. Product development as part of a positioning strategy for the hunting industry in the Eastern Cape. PhD thesis, Port Elizabeth Technikon, South Africa.

Van Rooyen, J., 2008. A short overview note: in search of a paradigm? Proceedings of the Satellite Symposium on The Role of Livestock in Developing Communities: Enhancing multi-functionality, Cape Town, South Africa. UFS and ILRI.

Wessels, H.W., 2011. ‘n Ondersoek na die ekonomiese volhoubaarheid van semi-intensiewe en intensiewe skaapboerdery in die Oostelike Hoëveld Streek van Suid-Afrika. Master’s thesis, University of the Free State, South Africa.

William, T., 2005. The extension sheep specialist. The Original Manuscript of Sheep Production and Management 86(11), 3252–3274.

Williams, R.E., 2010. Veterinary entomology. Livestock and companion animals. CRC press, Taylor and Francis Group.

World Bank, 2008. World development report. World Bank.

Yamane, T., 1967. *Statistics: An introductory analysis*. 2nd ed. New York: Harper & Row.

Zander, D.V., Bermudez, A.J., & Mallinson, E.T., 1997. Principles of disease prevention: diagnosis and control (10th ed.). Mosby-Wolfe.

Zenda, M. & Malan, P.J., 2021. The sustainability of small-scale sheep farming systems in the Northern Cape (Hantam Karoo), South Africa. S. Afr. J. Agric. Ext. 49(1), 105–121.

Zenda, T. and Malan, P.J., 2024**.** Constraints and support needs of smallholder sheep farmers in the Northern Cape Province, South Africa. *South African Journal of Agricultural Extension*, 52(1), pp.22–41.

Zoetis, 2020. Dosing guns, injectors and maintenance. https://www.zoetis.co.uk/livestock-farming/useful-resources/pdfs-and-images/VPS_applicator_and_Injector_Guide_2020.pdf