# Economic Analysis of Intensive Sheep Production Systems in Central South Africa

**By**

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# VERKLARING

"Ek verklaar hiermee dat die verhandeling wat hierby vir die graad MAGISTER SCIENTIAE AGRICULTURAE (M.Sc. Agric.) Landbou-ekonomie aan die Universiteit van die Vrystaat deur my ingedien word, my selfstandige werk is en nie voorheen deur my vir 'n graad aan 'n ander Universiteit/Fakulteit ingedien is nie. Ek doen voorts afstand van outeursreg in die verhandeling ten gunste van die Universiteit van die Vrystaat".

____________________________

Abraham Marthinus Landman

Caledon

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## ABSTRACT

Small stock production has a few challenges in predation, stock theft, variable rainfall patterns and rising production costs but livestock production is a very important industry in South Africa. There is a growing interest in intensive sheep production systems using irrigated pastures. Wool prices and reasonable meat prices encourage sheep production, especially woolled sheep farming. In this study the profitability and efficiency of different sheep production systems are evaluated and discussed.

Simulation models are widely used to simulate farming scenarios because data collection, such as reproductive responses can take long. The *Agri Benchmark* methodology with the TIPI-CAL simulation model were applied by constructing a typical farm for four different sheep production systems, namely extensive sheep production: rangeland only, semi-extensive sheep production: rangeland supported by irrigated pastures and two intensive sheep production system using irrigated pastures and silage respectively for production.

The primary objective of this study was to evaluate the profitability and efficiency of two intensive sheep production system compared to two extensive systems. The aim was also to identify the critical management issues of intensive sheep production systems.

Each system was evaluated in terms of its economic situation on a whole farm level. That includes the total income and profit margins of the system expressed as total mutton production per ewe. Market returns and the total live weight sold per ewe were the highest in the irrigated pasture system. Ewe productivity was the highest on the irrigated pastures and the silage system the most effective with the highest lamb growth rates. The cost of producing a lamb in the silage system is R500.50 per lamb. The non-factor costs (feed purchased, seed, and fertiliser) are the greatest contributor to total costs. The capital-, land- and labour costs were in percentage the highest in the extensive systems. Labour costs are high, with the silage system showing the highest labour productivity levels given per kilogram mutton sold per hour of labour input. Wool returns/income is almost the same percentage for all the systems.

All four the sheep production systems are profitable over the long term with a positive profit margin. Total returns on capital invested, measuring the efficiency of the sheep production showed, that despite high costs and capital requirements, as with the silage system, it is the second highest in terms of the returns on capital invested. Management is the key word to the successes of any sheep production system and includes critical management issues in terms of fodder planning (pasture management), health management and control of effective feeding.

The generated information can be used in future research as part of the national and international *Agri Benchmark* project. Different irrigated pastures and breakeven stocking rates for these pastures can be researched. The effects of policy changes can also be simulated.

# Ekonomiese Analise van Intensiewe Skaapproduksie Sisteme in Sentraal Suid-Afrika

deur

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## SAMEVATTING

Kleinvee produksie het ‘n paar uitdagings in predasie, veediefstal, veranderde reënvalpatrone en stygende produksiekoste, maar die produksie van lewende haweis ‘n baie belangrike bedryf in Suid-Afrika. Daar is ‘n groeiende belangstelling in die intensiewe skaapproduksie stelsels met behulp van besproeide weidings. Wolpryse en redelike vleispryse moedig skaapproduksie aan, veral wolskaapboerdery. In hierdie studie word die winsgewendheid en doeltreffendheid van verskillende skaapproduksie stelsels geëvalueer en bespreek.

Simulasiemodelle word wyd gebruik om boerdery scenario's te simuleer omdat data-insameling soos reproduksie data lank kan neem. Die *Agri Benchmark* metodologie met die TIPI-CAL simulasie model is gebaseer op die bou van 'n tipiese plaas vir vier verskillende skaap produksie stelsels, naamlik ekstensiewe skaapproduksie: slegs weiveld, semi-ekstensiewe kleinvee produksie: weiveld ondersteun deur besproeide weiding en twee intensiewe skaapproduksie stelsels nl. besproeide weiding en kuilvoer.

Die primêre doel van hierdie studie was om die winsgewendheid en doeltreffendheid van die twee intensiewe skaapproduksie stelsels te evalueer in vergelyking met die twee ekstensiewe stelsels. Die doel is ook dat hierdie studie gebruik word om die kritieke kwessies van intensiewe skaap produksie stelsels te identifiseer.

Elke stelsel is geëvalueer in terme van die ekonomiese situasie van elke stelsel op 'n geheelplaas. Dit sluit onder andere die totale inkomste en wins marges van die stelsel met die totale skaapvleisproduksie per ooi in. Mark-opbrengste en die totale lewende gewig per ooi verkoop was die hoogste in die besproeide weiding stelsel. Ooi produktiwiteit was die hoogste op die besproeide weiding en die kuilvoer was die mees effektiefste met die hoogste groeitempo van lammers. Die koste om een lam in die kuilvoer stelsel te produseer is R500.50. Die nie-faktor koste (voer gekoop, saad en kunsmis) is persentasiegewys die grootste bydraer tot die totale koste. Die kapitaal, grond- en arbeidskoste is die hoogste in die ekstensiewe stelsels persentasiegewys. Arbeidskoste is hoog, met die kuilvoer met die hoogste vlakke van produktiwiteit vir arbeid per kilogram skaapvleis verkoop per uur arbeidsinset. Wol omset / inkomste is byna dieselfde persentasie samestelling vir al die stelsels.

Al vier die skaapproduksie stelsels is oor die lang termyn winsgewend met 'n positiewe wins marge. Totale opbrengs op kapitaal geinvesteer is die meting van die doeltreffendheid van skaapproduksie. Dit het getoon dat ten spyte van die hoë kostes en kapitale vereistes van die kuilvoer stelsel, dit die tweede hoogste is in terme van opbrengs op kapitaal belê. Bestuur bly die sleutel woord tot die sukses van enige skaapproduksie stelsel en die kritieke kwessies is voervloei beplanning (weidingsbestuur), gesondheidsbestuur en beheer van effektiewe voeding.

Die inligting kan gebruik word in toekomstige navorsing as deel van die nasionale en

internasionale *Agri Benchmark* projek. Verskillende besproeide weidings en gelykbreek veeladings op hierdie besproeide weidings kan nagevors word. Die effekte van beleids veranderings kan gesimuleerd word.

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# CHAPTER 1

# Introduction

Small stock production in South Africa is primarily dependent on natural vegetation as nutrient source (Bezuidenhout, 1987). In an area with variable rainfall patterns and cold winters; one of possibly the biggest challenges in the animal enterprise is fodder flow planning. Increasing problems with predators, stock theft and climate change (Kingwill, 2011) and the issue of rising production costs (Smith, 2004) are other challenges for the industry (Nel *et al.*, 2010 & Wessels, 2011). Especially in the Southern Free State where pastures is only a side-line enterprise on a scale not always viable due to rising fuel and implement prices (cultivation costs) (Smith, 2004). The big variation in natural veld conditions, especially during winter and early spring, together with difficult marketing conditions makes intensive farm management a crucial factor to take into account in order to produce the correct product at the right time. South African agriculture has enormous challenges in terms of weather conditions. Rainfall in central South Africa (southern Free State) where the study focused is a huge concern, but with strategic irrigation, that can be eliminated to a certain degree. Factors such as temperature and daylight length then come into play for forage production.

## 1.1 Problem statement and need for study

Irrigated pastures are used with great success by dairy farmers (Botha, 2003 and Truter & Dannhauser, 2011) and lately, by sheep farmers in parts of South Africa (Wessels, 2011), ensuring better availability of quality fodder. The major increases in electricity tariffs and lowering gross margins, due to precarious grain prices of recent years, have compelled farmers to look at alternatives. The interest in sheep farming on irrigated pastures was further encouraged by the increase and better than normal mutton and wool prices over the last two years; making woolled sheep farming an attractive option. In the United States farmers were also forced to return to pasture based livestock operations, because dairy and beef production costs increased dramatically and due to environmental concerns of confined feeding practices (Corson *et al*., 2007). The perception exist that irrigation systems are expensive and therefore not economically viable. However, the assumption is that irrigation systems might be economically viable.

The aim of the study was to evaluate different sheep production systems by evaluating their efficiency and profitability potentials. The aim therefore was to identify the system with the potential for the highest return on investments.

The primary aim of any farmer must be to maximise a stable, sustainable income from his farming enterprise, certain return on investment and a good stable marketing strategy. This means choosing a livestock production system that is consistent with the forage producing capabilities of the farm (Klug *et al.*, 1999).

## 1.2 Objectives

The study focussed on the sheep industry with the main field of study being production and marketing of mutton and wool. The overall goal of the study was to evaluate the efficiency and profitability of four sheep production systems in central South Africa.

The objectives of the study included:

1. Evaluating the profitability of four alternative sheep production systems.

1.1 The capital requirements of the sheep production systems.
1.2 The effect of labour inputs between the sheep production systems.
1.3 The effect of liabilities on the profitability of each production system.

2. Analyse the fodder flow of each sheep production systems to evaluate the availability of fodder throughout the year and its effect on profitability.

3. Identify critical management issues for intensive sheep production systems on irrigated pastures and silage.

## 1.3 Motivation

Sheep farming on irrigated pastures could realise a positive net farm income (Du Plessis, undated & Londt, 2010), but to establish and maintain pastures are expensive. Irrigated pastures can be a viable alternative to crop production, but greater profitability will be more readily achieved if producers avoid costly mistakes (Smith, 2007). Careful planning is therefore a necessity. Coetzee (2010) identified that one of the differences between producers with high- and low profitability is plánning. The producer that generates higher profits, set targets for himself, re-evaluate them and change accordingly (adaptive management) in comparison with other producers with no targets.

Returns on investment on irrigated pastures are generally higher than returns from extensive farming practices, but comes with increased levels of management (Roeder, 2007a). Wessels (2011) also stated that intensive sheep farming requires higher capital en labour inputs. Du Plessis (undated) identified important factors when considering irrigated pastures as being:

- initial capital,
- availability of water and electricity (Bezuidenhout, 1987)
- the cost of water and electricity (Breytenbach *et al.*, 1996)
- above average pasture-, and
- sheep management

The investment needed to establish irrigated pastures, especially under irrigation, is capital intensive and therefore above average management is when establishing irrigated pastures, to achieve financial success (Du Plessis, undated). In practice the farmer rarely does any precise costing of an enterprise; however no farming operation should be undertaken without accurate economic analysis and planning (Du Plessis, undated).

Limited farmland could be a further motivation for farmers to start intensifying and diversification of the utilisation of their available resources. Hofstrand (2008) asked the question whether the farm manager needs to specialise or diversify. The conclusion was the manager should specialise in labour and management while diversifying his income resources. This conclusion is supported based on the fact that the agricultural producer is almost always a price taker and therefore need to spread the income risks. Either market the products in more than one market or market more than one product like mutton and wool, which at the end serves different markets. Except for better marketing, the producer cannot do much about the prices received but can increase the efficiency of labour and the management's inputs into production.

Establishment of irrigated pastures could be a possible option as a:

- strategy to growth,
- risk management (intensification opens opportunities for diversification), and
- increase product quality.

This study evaluated four sheep production systems (mutton and wool) with two of the systems on natural veld under extensive conditions. The other two systems were one on irrigated pastures and the other using silage from maize and peas to feed the sheep.

### 1.3.1 Growth strategies

Growth strategies may take many forms and directions. Hofstrand (2007) argues that specialising, intensifying and diversification are all strategies to grow the business. Diversification is another form of horizontal expansion. It is important to notice that diversification might reduce efficiency, because management is spread over enterprises (Hofstrand, 2007).

### 1.3.2 Diversification

An example of risk management is diversification of assets or business enterprises (Barry *et al.,* 1995). A study done by the Australian Sheep Industry Cooperative Research Centre found that a dual-purpose Merino (meat-wool) enterprise offers producers flexibility against changes in commodity prices, but producers should however still pay close attention to the genetic merit of the ewes they purchase or breed (Sheep CRC, 2006). The use of irrigated pastures in the study was investigated as an option to diversify current sheep farming systems. It lowers the risk of high quality fodder availability, thus reducing production risk. The product supply in this case, wool and mutton, is stabilised and supply risk is lowered which lowers income risks.

According to Esmail 1991, income may increase with the use of multi-species (or woolled sheep producing mutton and wool) grazing because producers then have more than one product to sale and the timing of sales may improve cash flow. The use of Merino sheep in all the production systems of the study may have a positive effect on cash flow management because they produce mutton and wool. Income thus occurs on different times during the financial year, possibly minimising cash flow problems sometimes occurring in the farming business.

### 1.3.3 Quality products

Availability of quality fodder can increase the quality of the wool produced through higher clean yield percentages and better staple strength. The microns of the wool need to be monitored, because it will strengthen on the quality pastures (Clayfield, 2012).

It is important not to change to sheep production systems using irrigated pasture or some other form of intensive sheep enterprise without careful planning and consideration. Changing enterprises without careful planning is not always a good idea, because it has costs and risks (Warn *et al.*, 2006). According to Sheep CRC (2006) there are some important factors to take into consideration before changing or expanding enterprises, such as a cost analysis of the expected price trends and how the price relatives will change between grain, meat and wool in the future.

One of the facets the study will look at is the effect of capital expenses of the different sheep production systems. Careful planning and consideration is therefore of outmost importance when considering enterprise changes. Farmers have the tendency to change between breeds because of short term price fluctuations in mutton and wool, but that is not always a viable option (Snyman & Herselman, 2005 & Van Pletzen *et al.*, 2006). There are big genetic differences within breeds that have to be narrowed through selection and breeding (Van Pletzen *et al.*, 2006).

## 1.4 Background

### 1.4.1 Sheep production systems

The sheep production systems can be specified and detailed in terms of animals, management, irrigation systems and feeding. The sheep production systems used as baseline systems for this study had to comply with the following:

1. **Size:** The farm must at least have 1000 ewes
2. **Irrigation systems:** Pivot irrigation systems were used in the sheep production systems to produce fodder
3. **Natural veld:** Sheep production on natural vegetation under dryland conditions
4. **Pastures:** Irrigated pasture production. *Medicago sativa* (Lucerne), *Trifolium pratense* (red clover), *Trifolium repens* (white clover) and grasses such as *Lolium perenne* (Perennial ryegrass), *Lolium multiflorum* (Annual ryegrass), *Festuca arundinaceae* (Tall fescue), *Phalaris aquatic* (Canary Islands grass), *Dactylis glomerata* (Cocksfoot grass) were used as pastures
5. **Silage:** Maize and peas were produced for silage production in one of the systems

6. **Specie:** All the sheep production systems used Merino sheep

Four sheep production systems were examined, namely: (1) natural veld, Colesberg, (2) irrigated pastures, Luckhoff (3) natural veld, Edenburg and (4) sheep production on silage, Hopetown.

1. Natural veld (Colesberg)

   It was one of the two extensive natural grazing enterprises compared to the other more intensive systems. This extensive system together with the other natural veld system will be used as a control to compare the other systems against. The comparisons will be in terms of returns on investment and kilograms of mutton and wool produced. The sheep utilised natural vegetation as their only source of feed with minimum supplementary feeding. The animals were more exposed to predators, theft and fluctuating weather conditions.

2. Irrigated pastures (Luckhoff)

   The irrigated pastures include *Medicago sativa* in combination with a grass-clover mixture under a centre pivot irrigation systems. Merino sheep utilise these pastures with different pasture programs to manage fodder flow. These pastures provide enough dry material for the whole year except in the winter months from June to middle August. Surplus fodder during summer might be used for these months or fodder should be bought.

3. Natural veld (Edenburg)

   It was also a natural grazing enterprise where the sheep utilised natural vegetation as their main source of feed. The fodder flow program is supplemented with seasonal irrigated pastures on small scale, mainly for use during lambing season. The animals were also more exposed to predators, theft and fluctuating weather conditions.

4. Silage (Hopetown)

The whole flock of sheep were kraal based and fed with only silage for nine months in a year when the ewes were not in production (dry), thus a full feeding system. The silage was produced by the farmer himself mainly from maize and peas. Natural veld was used for a short period of three months when the sheep were not in a productive cycle.

The question is; what will the return on investment of this capital intensive system when compared to grazing systems (Jennings, 2011) be and how will the different sheep production systems compare in terms of returns on investment?

### 1.4.2 Critical management issues

The aim of this guide is to help producers identify the critical issues when considering more intensive sheep producing systems. According to the literature reviewed in Chapter 3 the most important aspects of sheep production, especially on profitability in the more intensive systems are: reproduction, the speed of lamb growth and ewe condition (because it has an effect on next year's reproductive figures) and the improvement of growth through better quality forage and availability in critical stages of reproduction and during the growth phases of the lamb. The system that provides the best profit or return on investment given all management factors such as labour, theft, predators, irrigation and electricity, will be selected.

The impact of predators on the livestock industry is underestimated. In 2007 the Red Meat Producers' Organisation made a statement, saying that the predator situation is a bigger problem than animal theft. It is measured that farmers lose up to 8% (2.8 million in numbers) of their small livestock to predators (Van Niekerk *et al.*, 2009). According to Gerhard Schutte, Chief Director of the RPO, farmers' losses are R1.4 *milliard* per year (Van Niekerk, 2010) to predators and that is four times more than losses through animal theft (Botha, 2009).

The study focussed on the return on investment at different levels of risk associated with the different sheep production systems. The following is a short explanation on principles used to compare between alternative production systems according to Van Zyl *et al.* (1999).

### 1.4.3 Economic principles

#### 1.4.3.1 Profitability

Profitability is the percentage ratio between profit earned during a particular period and the capital to realize those gains. In other words "interest on capital". It is thus possible for the producer to compare his interest on capital against interests from alternative investments (Van Zyl *et al.*, 1999). The main measurement of profitability in agriculture is farming- or business profitability.

$$\text{Profitability on total capital} = \frac{\text{Net Farm Income (NFI)}}{\text{Average total capital utilised}} \times \frac{100}{1}$$

## 1.5 Sheep breed

The sheep breed used in all the sheep production systems, were Merino sheep. According to Dr. C.A. van der Merwe "The merino is the only sheep in the world that can produce 10-15% of its own live mass in clean wool. Results from Cloete *et al.* (2004) showed that pure bred Merinos are extremely competitive in terms of economic yield when considering the combination of relatively small size with acceptable reproduction and high levels of fibre production. The main products produced on these systems by the Merino sheep were wool and mutton.

In 2011, wool sheep in South Africa made out 71.71% of the total South African sheep breed composition, where 52.35% of that total was Merino sheep. It is evident from

Figure 1.1 that the Merino breed is very import in South Africa with over 52% percent of total sheep in South Africa being Merino's.

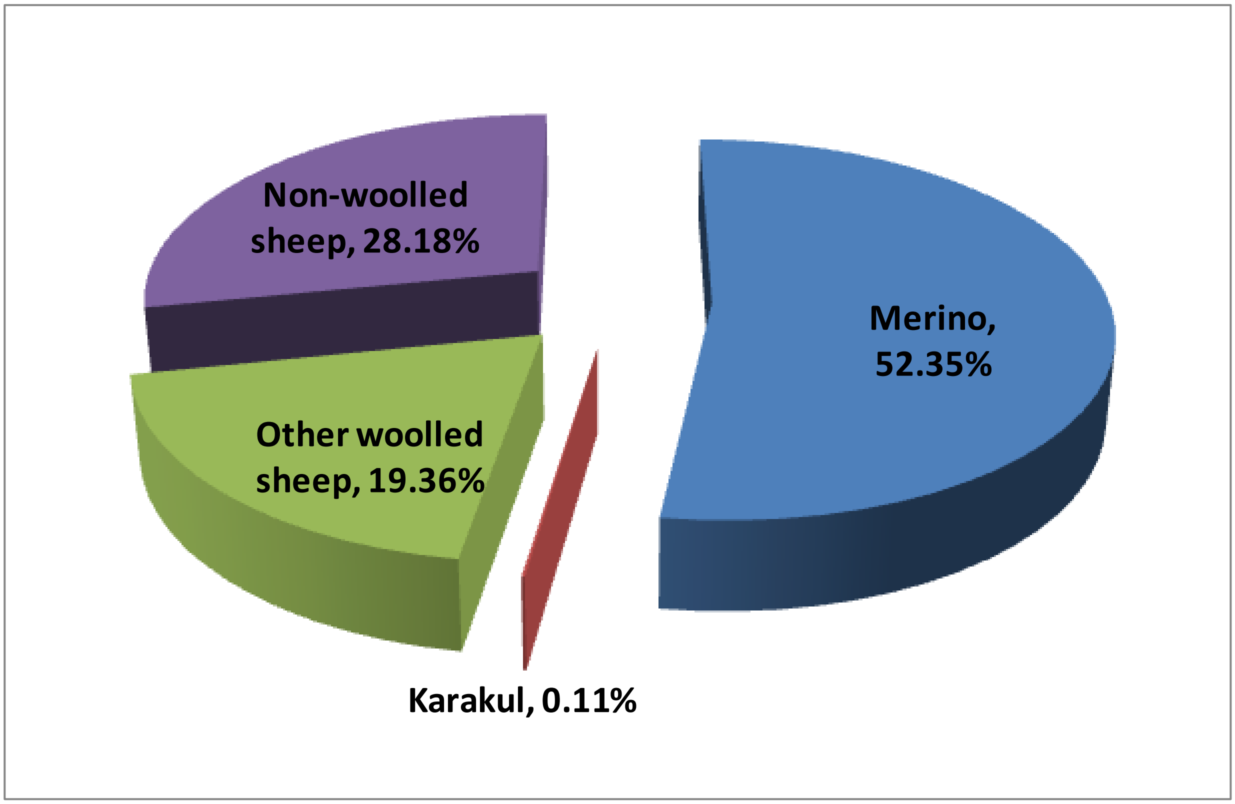


**Figure 1.1: South African sheep breed composition** (NDA, 2012)

## 1.6 Methodology used

A relatively new methodology was applied to this study. The *Agri Benchmark*, global network methodology where information was collected through the construction of a typical farm. It takes into consideration total capital, land-, labour- and allocative expenses such as depreciation. The South African farms in the *Agri Benchmark* network do reasonably well, especially when compared to countries like Australia, Argentina and Mexico. However there is room for improvement, according to Deblitz (2012).

This study adds new farms to be tested with the emphasis on comparisons between different types of sheep production systems.

# CHAPTER 2

# Methodology

## 2.1 Introduction

This chapter focus on the research method used to collect and analyse data on the profitability and sustainability of intensive sheep production systems by using the *Agri Benchmark* methodology. The International *Agri Benchmark* project is a global network of farm economists using standardised questionnaires to collect data to generate sustainable, comparable, quantified information about farming systems, their economics, their framework conditions and perspectives worldwide (Deblitz & Zimmer, 2007). The basic methodology used in the *Agri Benchmark* models for data collection and analysis of the data from the questionnaires (Appendix A) was also used for this study.

## 2.2 Study area

The study was conducted in central South Africa (Figure 2.1) with Colesberg, Luckhoff, Edenburg and Hopetown being the central towns where the sheep production systems were situated.

Colesberg and Hopetown are situated in the Northern Cape, Luckhoff close to the border with Northern Cape on the Free State side and Edenburg also in the Free State. The Orange river runs through the study area and is in many ways a life line for the region. The sheep production systems on silage- and irrigated pastures respectively are downstream from the Van der Kloof dam.


**Figure 2.1: A map of central South Africa in which the study area is located** (Anonym A, 2013)

## 2.2.1 Identification of sheep production systems

Dairy farmers use irrigated pastures with great success (Botha, 2003 and Truter & Dannhauser, 2011) and lately, also by sheep farmers in parts of South Africa (Wessels, 2011). Therefore it was essential for this study not to choose any available sheep production system to include in the research, but rather look for existing systems that were in production and well positioned for about two to three years. The four sheep production systems were further selected based on the criteria that they are in size, bigger than 1000 ewes. The pasture must be produced under irrigation or the crops produced for feed rations (silage) must be irrigated. The extensive system is a natural veld system with no irrigation; while the semi-extensive sheep production system utilising natural veld with a small part of irrigated pastures as strategic feeding.

South Africa was divided into biomes first by Acocks (1953), with the study area situated in the Nama-Karoo biome. It is South Africa's largest biome dominated by vegetation comprising of shrubs, dwarf shrubs and grasses. This natural vegetation is the main food supply for sheep production in this region. Rainfall is moderate (250-450mm per annum), but can be sporadic (Palmer & Ainslie, 2002 & Duras, 2008). The carrying capacity of the sheep production system using irrigated pastures was on average about 30 ewes with lambs per hectare. The carrying capacity of the regions where the natural veld systems were situated is between 10 and 15 hectares per large stock unit for Edenburg and Colesberg respectively (ARC, undated).

#### 2.2.1.1 Extensive Sheep Production: Rangeland only

The chosen production system was situated in the Colesberg (Northern Cape) district with the veld consisting of mainly grassland and Karoo bushes. It is a complete extensive natural grazing enterprise in comparison to the other irrigated systems. The only source of feed utilised by the sheep is natural vegetation. The sheep are exposed to effects such as predators, theft and extreme weather conditions. The only supplementary feed given for the sheep in this production system is rock salt.

#### 2.2.1.2 Semi-extensive Sheep Production: Rangeland supported by irrigated pastures

This production system was situated in the Edenburg district in the Free State also with a complete extensive natural grazing enterprise with irrigated pastures as supplementary feed to utilise during winter and lambing season. The main source of feed for the sheep was the natural vegetation, consisting mainly of grassland and a few Karoo bushes. The grassland portion of the natural veld is larger in this system, if compared to the Colesberg system (Acocks, 1953).

**2.2.1.3 Intensive Sheep Production: Irrigated pastures**

The irrigated pastures system was situated close to Luckhoff (Northern Cape). The pasture is irrigated by centre pivot from the Orange River and consists mainly of *Medicago sativa* (Lucerne), *Dactylis glomerata* (Cocksfoot grass), *Festuca arundinaceae* (Tall Fescue), *Lolium multiflorum* (Annual Ryegrass), *Lolium perenne* (Perennial Ryegrass), *Phalaris aquatica* (Canary Islands grass), *Trifolium pratense* (red clover) and *Trifolium repens* (white clover). The sheep utilise the pasture directly for the entire year.

**2.2.1.4 Intensive Sheep Production: Silage system**

This production system was in the Hopetown (Northern Cape) district near the Orange River. The crops used for silage production are irrigated from the Orange River by centre pivot. Silage is mainly made from maize and peas and was fed to the sheep that were kraal based for about nine months. During the three months when the ewes were not in a productive state, they grazed on the natural veld. The system, Figure 2.2, was basically a full feeding system with the sheep kraal based for nine months.

**Figure 2.2: Ewes in silage production system** (Own material)

## 2.3 Simulation models

Livestock farming is not just an art any more. According to Wessels (2011) farming is a highly technological and scientific business venture. This study was not just a mathematical model that's been run with data from a survey in order to get to an answer. This is a multi-discipline study where a lot of factors had to be considered, even the biological characteristics of agriculture that is so unpredictable. Factors that were addressed include the following:

1. climate, i.e. weather;
2. irrigation system;
3. pasture species;
4. pasture management;
5. sheep breeds;
6. animal management;

- Health management;
- Predator control; and
- Theft control.

This study includes a lot of information about these factors that needs to be well managed to be economically successful (Breytenbach *et al.* (1996); Snyman & Herselman, 2005; Beukes *et al*., 2008; Calldo *et al*., undated and Du Toit, 2008).

An enterprise budget is a way to examine both the physical and economic characteristics of a specific enterprise (Schuster and Luening, 2003). Enterprise budgets are basically a cost and return estimate that is determined for ‘n specific enterprise. Frank (2000) defined an enterprise as: “any coherent portion of the general input/output structure of the farm business that can be separated and analysed as a distinct entity.”

Spedding (1988) argues that the ultimate goal of agricultural research should be to improve the whole farming system, not just a component of it. Thus, in order to compare different production systems (farms), one will have to look at whole farm analysis. Factors such as fixed cost are not taken into account when constructing ‘n enterprise budget. The enterprise budgets will therefore give a skew picture of which is the most profitable production system relishing the best return on capital. Analysis on enterprise level alone cannot be used in whole business benchmark outcomes (Ronan and Cleary, 2000 & Schuster and Luening, 2003). According to Thomson *et al*. (1995), a farmlet based experiment in Syria (Western Asia) found that the whole farm approach to enable measurement of the results of integrating crop, sheep and pasture components was an extremely informative and useful methodology.

Livestock systems research is very slow for a variety of reasons. Collecting reproductive performances data of animals or trends in rangeland utilisation at different stocking rates or variation in rainfall could take several years to complete. Models are therefore being developed to simulate certain scenarios, by using historical and present data.

Castellaro *et al*. (2006) describes the integration and interaction of two simulation models to accurately predict the response of sheep to grazing. One goal of this study is to generate process and analysis information to make decisions in the whole productive process that is better and more informed. Spreadsheet models are powerful and convenient tools (Woodford, 1985), which is well suited to financial analysis or to simulate restricted grazing systems as described by Morley (1987).

A computer model of a grazing system is a series of mathematical equations that mimic the complex processes of the system (Rickert, 1988). Computer models can be in the form of spreadsheets, linear programming, dynamic simulation and expert systems.

A few examples of simulation models from the literature are shortly discussed. In Castellaro *et al*. (2006) a simulation model was developed as a tool for supporting management's decision-making and to allow the evaluation of different production alternatives. The SPUR (Simulation of Production and Utilisation of Rangeland) model were modified and used by Stout (1994) to predict switch grass (*Panicum virgatum*) growth in northern Appalachia (USA). The Integrated Farm System Model (IFSM) in Rotz *et al*. (1999) predicts weather and management effects on hydrology and soil nutrient dynamics, forage and crop yields, harvest, handling and feeding of crops, milk or beef production, manure management and farm economics at a whole-farm scale. Donnelly *et al*. (1987) describes a simulation model (GRAZPLAN) that simulates the biological and management processes on a farm, in order to optimise (in financial terms) the strategy that should be followed in any specific environment.

The purpose of the Farm Simulation Framework (FSF) in McCall & Bishop-Hurley (2003) is to complement field research in identifying opportunities for improved dairy farm profitability, whereas Corson *et al*. (2007) conclude that a refined whole-farm model will provide a useful research and teaching tool for evaluating and comparing the long-term economic and environmental sustainability of a production system. The Whole-Farm model (WFM) as discussed by Beukes *et al*. (2008) had acceptable accuracy in pasture prediction and can also be used to compare management strategies and economics for a range of pastoral systems for both research trial design and for actual farms.

The number and diversity of models that have been published are perhaps a result of the complexity and challenges in livestock production with the huge number of variables influencing production. Warn *et al*. (2006) used the GrassGro version 2.4.3 simulation model because they are fast, inexpensive and can be readily changed with new circumstances to quantify enterprise changes.

The TIPI-CAL (Technology Impact and Policy Impact Calculations) program used for this study is a simulation model, which is the central processing unit to calculate farm data in the *Agri Benchmark* methodology. The model allows the simulation of farms and contains a comprehensive set of analytical tools for benchmarking (returns, costs and profitability) and data analysis. Data and scenario management for policy and farm strategy analysis is also available (Deblitz & Zimmer, 2007 and Deblitz, 2010).

## 2.4 Research methodology

Benchmarking is a tool for assessing and comparing different businesses and organisations within a certain sector. The major methodological (and organisational) achievement of *Agri Benchmark* is probably to set standards, make them transparent and apply them on international level (Deblitz, 2010). The method were used by Uddin *et al*. (2010) and refined to be suited internationally. It comprises of two major parts (A) Typical Farm Approach to select typical farms, data collection and data validation and (B) Analytical model (TIPI-CAL model) that is used to analyse the data. The main capability of the network is comparative analysis; comparing income and cost of production, as well as margin and profits over short and long term of ‘typical farms’ (Deblitz, 2011).

Advantages of *Agri Benchmark*

The use of the standardised questionnaire of *Agri Benchmark* has the following advantages:

- ✓ benchmarking is a tool for assessing and comparing different businesses and organisations within a certain sector
- ✓ comparative analysis of the profit and the costs of production
- ✓ the establishment of a local Agri-Benchmark sheep network will further broaden the views and understanding of participants in the sheep (mutton, lamb as well as wool) value chains and it is embedded in national and international markets
- ✓ it will further also enhance the understanding of production systems and their drivers, both nationally and globally (Deblitz and Zimmer, 2007)

### 2.4.1 Questionnaire used and data collection

The TIPI-CAL (Technology Impact and Policy Impact Calculations) Questionnaire of *Agri Benchmark* is a standardised questionnaire developed to collect farm data of a typical farm for a region to asses and compare data within a sector internationally. The questionnaire contains an overview of the whole farm data, followed by data on crop and forage production and then data of the ewe enterprise (Deblitz and Zimmer, 2007). The same standardised questionnaire, as developed by Deblitz and Zimmer (2007), covering production and economic figures, were used to construct the four typical sheep production systems in this study. The standardised questionnaire as it was developed was used for this study because the data had to be available in a specific format to simulate the typical farms through the simulation model TIPI-CAL. Two farmers per typical sheep production system were interviewed to 'build' a typical sheep production system (Deblitz and Zimmer, 2007). According to the training files from *Agri Benchmark* in Anonym B (2011) one or two farmers is enough when the data is used for benchmarking, cost comparisons, production system comparisons and policy analysis. The two farmers from the intensive sheep production system using silage as fodder were from the same farm, thus not farmers from different farms. The availability of silage systems for sheep production was very low. The two farmers however took part in discussing the system and whether the practices they apply is the best for a typical farm. Edenburg was the only farm where more than two farmers were part of the construction the typical farm, namely four.

Face to face interviews were used to administrate the questionnaires with the application of the *Agri Benchmark* methodology. A so-called ‘panel’ consisting of the responsible scientist and the farmers meet to complete the questionnaire. The panel holds a meeting where they create a consensus on each figure to properly describe how a typical farm would look. The standardised *Agri Benchmark* questionnaire was completed with the figures of a typical farm (Deblitz and Zimmer, 2007). It also allowed time for discussions about certain aspects of the specific system and whether the farmer’s way is the best way of handling certain factors, because the *Agri Benchmark* methodology uses the principle of constructing a “typical” farm. The question asked when entering a figure was: “Is this figure typical for the region or system?” The same approach followed in Deblitz and Zimmer (2007) with constructing a “typical” farm was duplicated in this study.

The sampling methods of typical farm data, average farm data and individual farm data are compared in Table 1 according to eight characteristics (Anonym B, 2011). The typical farm data shows positives for all the characteristics, but for representativity it has strengths and weaknesses. It highlights the fact that when collecting data for a typical farm, it is very important to insert the correct and average data of the region that the farm represents.

The completed questionnaires were sent to Agralys GbR, scientific partner of the international *Agri Benchmark* Beef and Sheep Network, to be analysed with the *Agri Benchmark* program due to a lack of time for the model and methodology used to be learned. Locally there was a lack of knowledge and experience. The analysed data was sent back in Excel format, calculated by the TIPI-CAL simulation model. The program also generates standard graphs and has a function to draw alternative graphs if required. The results and discussion thereof will follow in chapter four.

**Table 1: Typical farm data vs. individual farm data (Anonym B, 2011)**

| **Characteristics** | **Individual farm data** | **Average farm data (surveys)** | **Typical farm data** |
|---|---|---|---|
| Representativity | - | + | + / - |
| Consistency (data sets) | + | - | + |
| Quantity structure | + | - | + |
| Data availability | + | + / - | + |
| Up to date | + | - | + |
| Feasibility data collection | + | - | + |
| Data confidentiality | - | + | + |
| Cost data collection | + / - | + / - | + |
| + = Strength of the sample method; - = weakness of the sample method | | | |

The following assumptions were made regarding the *Agri Benchmark* questionnaire during data collection. The reasons for these assumptions were to build a 'typical' farm but to exclude the managers' influence on the system, because we want to compare the four sheep production systems and not the different management styles of the farmers:

- all values exclude VAT
- machinery and equipment's prices were taken to be equal given the specifications were matching. For example, if two of the sheep production systems used a 74Kw tractor each, the assumption is made that both were bought in the same year and at the same price
- the same principle as with the machinery and equipment were used given there specifications were the same. Example here is labour houses, where the year of purchase and purchase price of these houses were taken to be equal between the four production systems
- in terms of liabilities, the four production systems were compared on two levels of liabilities, namely zero liabilities and liabilities worth 50% of capital invested in machinery, equipment, buildings and facilities per system. Land were assumed to be own land paid for by full
- the following fixed costs were taken as equal between the four systems:

    - water and electricity expenses for the farmstead,
    - accounting and
    - office expenses
- feed prices were taken as to be equal if the content used in the composition was the same.
- meat prices received were taken to be equal for all four systems per given category in the standardised questionnaire.
- specific wool costs were the same per head.

These assumptions were implemented to better compare the results of the different production systems. Data that has no influence on the unique characteristics of the systems, such as household expenses, were assumed to be the same for all the production systems. The questionnaire was completed with the help of the farmer of that unique production system and with the assumptions above kept in mind in order to construct a typical farm for each production system.

The data of the four sheep production systems were analysed with the analysis tools used in *Agri Benchmark*. This is mainly through the simulation model TIPI-CAL (Deblitz and Zimmer, 2007). The analysis gave indicators as explained in chapter four which can be used to identify the production system with the highest profitability.

### 2.4.2 Model specification

**TIPI-CAL** (**T**echnology **I**mpact and **P**olicy **I**mpact **Cal**culations) is an Excel-based spreadsheet simulation model and a good analytical tool for better understanding of farming systems through its focus on the analysis of returns, costs, profitability and productivity of enterprises (Deblitz *et al.*, 2003 & Uddin *et al*., 2010).

The Profit-and-loss (P&L) account and entrepreneurs profit calculations in the TIPI-CAL model runs with the following basic formula (Anonym C, 2011 & Uddin *et al*., 2010):

Profit-and-loss account:

Net Cash Farm Income (NCFI) = Total Returns (TR) – Total Expenditures (TE)

NCFI = Ewe returns (ER) – (Crop & Forage variable expenses (C/FVE) + ewe variable expenses (EVE) + Fixed expenses (FE) + Labour expenses (LaE) + Land expenses (LE) + Interest paid (I))

Therefore,

NCFI = TR – TE

= ER – (C/FVE + EVE + FE + LaE + LE + I)

Entrepreneurs profit:

Entrepreneurs profit (EP) = Farm income (FI) – Opportunity cost (OC)

EP = (NCI – Depreciation (D) ± Inventory changes (IC) ± Capital gains/losses (C)) – (Opportunity cost for interest for own capital (OCoc) + Opportunity cost for own land (OCol) + Opportunity cost for family labour wages (OClw))

Therefore,

EP = FI - OC

= (NCI – D ± IC ± C) – (OCoc + OCol + OClw)

The characteristics of TIPI-CAL are the following:

- excel spreadsheet
- dynamic-recursive calculation of cash-flow
- deterministic or stochastic mode of operation
- detailed price and quantity structure for the cash crop & forage production and sheep (ewes) enterprises.
- 10 years projection/simulation of the farm data for a) updating farm data from one year to the next and b) policy impact and farm strategy analysis.
- the main model output is a profit and loss account, a balance sheet and a cash-flow statement (Deblitz, 2010)

The TIPI-CAL model indicators are divided into four sub categories as illustrated in Table 2. Weaning percentage and weaning weight is probably the most important productivity figures when looking to produce weaned lambs. Lamb losses are perhaps the most important physical indicator.

According to Warn *et al.* (2006) the quantity mutton and/or wool produced per hectare, hence weaning percentage and stocking rate is key drivers of profit. It can be used to measure the effectiveness of the manager, where high lamb losses might indicate that management needs to improve. If not, the system will not be effective and profitability will decline and *vice versa*. It is also important to look at the cost of producing a certain weaning weight. The return per additional kilogram of weaning weight must be higher than the cost of producing it (Van Zyl *et al*., 1999).

The weaning age and the weight gained are reasonably manageable by the farmer. If the farmer provides optimal feed the lamb can gain optimal weight over a given period, given a good health program and environment. According to Neary (1992) lambs should not be weaned before the age of 60 days. Warn *et al.* (2006) argues that sale weight of lambs is not key drivers of profitability. Keeping lambs for longer to achieve higher weights decrease the number of ewes to be carried.

Land cost is calculated by adding the rents paid for rented land and the opportunity costs for own land (Deblitz, 2008). Opportunity cost is the value of the best alternative given up by choosing something else. According to Zimmer *et al.* (2011) the opportunity cost to the farmer using family labour, land and capital is the alternative income to these resources if the farmer quit farming and uses these recourses in other industries. For example: land cost in the model is the rent paid and instead of the farmer using his own land it could have been rented out, considered the opportunity cost of using it.

**Table 2: Indicators from the TIPI-CAL Model (Deblitz, 2008).**

| **Indicator** | **Description** |
|---|---|
| **Physical indicators** | |
| Replacement rate | It is determined by the culling rate and the ewe losses. For example, if the ewe are 5 years old when they are sent to be slaughtered (and being replaced), the replacement rate is 1/5 = 20 percent. If additionally ewe losses amount to 2 percent, the replacement rate would be 22 percent. |
| Age at first lamb | This is the age at which a ewe delivers her lamb. Hence, the first time she lambs. |
| Lamb losses | This is the percentage loss between the number of lambs (born) alive after one day and day of weaning. Thus, the number of lambs weaned divided by the number of lambs (born) alive, one day after birth. |
| | |
| **Productivity indicators** | |
| Weaning percentage | It is the number of lambs born alive minus the lamb losses until weaning, divided by the total number of ewes. |
| | |

| | |
|---|---|
| Weaning weight | The weaning weight is die live weight at the day of weaning. This is the weight taken as the sale or transfer weight of the weaner. The weight at weaning is determined by factors such as breed, weaning age and weight gain during suckling time. |
| Weaning age | The quality of feed provided to the lamb and marketing strategy has a big influence on the farmers decision when to wean. |
| | |
| Total live weight sold per ewe | That is the average total live weight (in kilograms) sold per ewe. |
| Profitability | It is the profit earned for a certain period given the capital used to generate it, expressed as a percentage. |
| Land Productivity | *Physical* - : is the kilogram live weight produced per ha land (hired and owned) input.<br>*Economic* - : is the total returns in Rand-value per Rand-value land cost. |
| Labour Productivity | *Physical* - : is the kilogram live weight produced per hour labour (hired and family) input.<br>*Economic* - : is the total returns in Rand-value per Rand-value labour cost. |
| | |
| **<u>Prices and returns</u>** | |
| Per weight price | This is the price per live weight at which the ewe or lamb is sold at. |
| Selling of weaner lambs | Lambs can be fed up to a certain weaner weight of – age, where they are sold. |
| Selling of breeding animals | This is animals such as replacement ewes that are in surplus, sold to other farmers as breeding animals. |

| **Total cost** | |
|---|---|
| Factor costs (FC): | Factor costs consist mainly of labour-, land- and capital costs. Land costs and labour costs are the main production factors in ewe-lamb production system. Own capital, liabilities, own land, rented land, family labour and paid labour costs are all included in factor costs. |
| Land cost | Is the paid rents and opportunity costs for own land. |
| Labour cost | Is the paid wages and opportunity costs for own (family) labour. |
| Capital cost | Capital cost is the interest paid plus the calculated interest for equity. |
| Non-factor costs (NFC): | The majority of NFC is related to feed purchase and production (seeds, fertiliser, pesticides, machinery, fuel, energy) |

The most important criteria of profitability according to Van Zyl *et al*. (1999) are farming profitability. It will also be the most important indicator from the model for this study, given the objectives stated in the introductory chapter. The objective of an agri business/farm is to maximise profits.

Profit is the difference between the value of the goods and services produced on the farm, and the costs of resources used in their production used (Van Zyl *et al*., 1999). It is the farmer's 'interest' on the capital he invested in his farming enterprise, in other words his return on capital (ROC). The farmer will look at this percentage of profitability and ask himself whether he could have done better by investing his capital in other investment portfolios like investing on the stock exchange. Farm profitability is the farm's income as a percentage of the average total capital used (Van Zyl *et al*., 1999).

$$\text{Farm profitability} = \frac{\text{Net Farm income}}{\text{Average Total capital used}} \times \frac{100}{1}$$

The indicators in Table 2 create the ability to look at the performance of the typical farms as a whole and the performance of the ewe enterprises of the different sheep production systems. This might show the important factors which have an influence on the ROC of the farming enterprise. The important indicators for the purpose of this study is profitability, because that is the farmer’s return on capital and he will have to decide whether he is satisfied with it or if he should consider different investments to maximise his return on capital.

The aim of this study is to identify which production system has the highest profitability as stipulated in the objectives in chapter one. The usage of the *Agri Benchmark* methodology makes it possible to use the data for future research when comparing typical sheep production systems from South Africa with international farms.

# Chapter 3

# Literature review

## 3.1 Sheep Production Industry background

The livestock production industry is the largest agricultural industry in South Africa (SA info, 2008 & Anonym D, 2009) and contributes over 49% to agricultural output. Approximately 80% of agricultural land in South Africa is mainly suitable for extensive livestock production (PGSA, 2009 & Anonym D, 2009). Sheep and goat farming occupies approximately 590 000 km² of land in South Africa. This represents 53% of all agricultural land in the country. The South African red meat industry will always be one of the most important sub-sectors of South African agriculture, because of South Africa's natural resources being available mostly to extensive livestock farming.

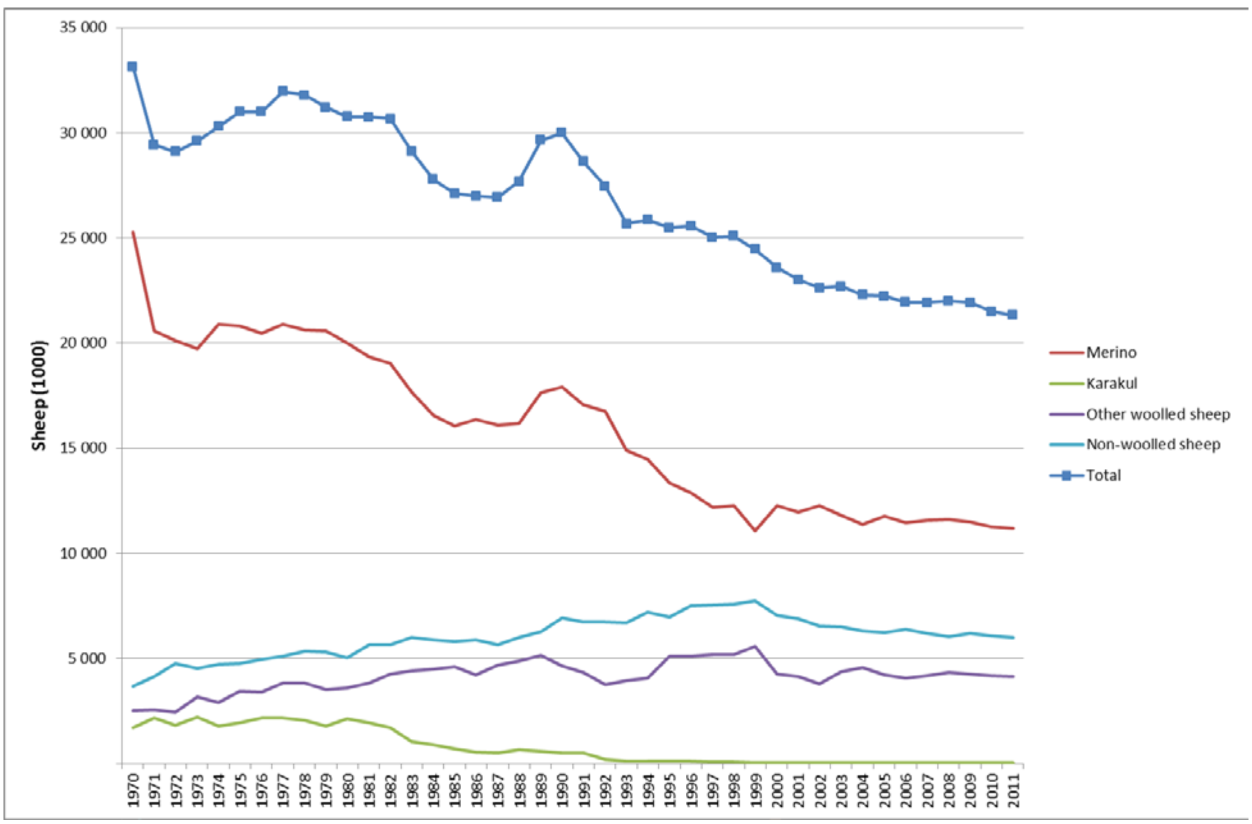


**Figure 3.1: South African Sheep numbers** (NDA, 2012)

The total number of sheep in the South African sheep industry shows a strong declining trend since 1978 but recovered well up to 1990. However, it declined steeply after the 1990's and stabilised at 23 million animals since 2006 (Figure 3.1).

The main reasons for this trend according to (Van Niekerk *et al*., 2009; Hoon, 2010 and Morokolo, 2011) being:

- increasing numbers of game farms
- severe drought in the early nineties
- escalation of stock theft and
- the negative effect of predators

The number of wool sheep declined quite dramatically with non-wool sheep showing an increase up to 2000 and declining slowly after that. In 1970 non-wool sheep contributed 11.08% to the total number of sheep in South Africa, with woolled sheep at 83.8%. The picture changed a lot over the last 40 years with non-wool sheep contributing 28.18% and woolled sheep 71.71% to the total number of sheep in 2011 (NDA, 2012).

The decline in total sheep numbers is mainly because wool sheep numbers dropped sharply, with non-wool sheep showing only a slight increase (NDA, 2012). In Nel & Hill (2007) and Hoon (2010) the issue of increasing game farms numbers parallel with declining sheep numbers is identified as a possible influence leading to the decline. The effects of the higher number of game farms on sheep numbers however haven't been measured in values. The decline should not be seen only as a negative factor, because it was also the result of improved stocking techniques, better land management and a reduction in number of farms, leading to more effective and sustainable farming practices (Nel & Hill, 2007). There is definitely a noticeable trend within South Africa towards game farming (ABSA Group Economic Research, 2003).

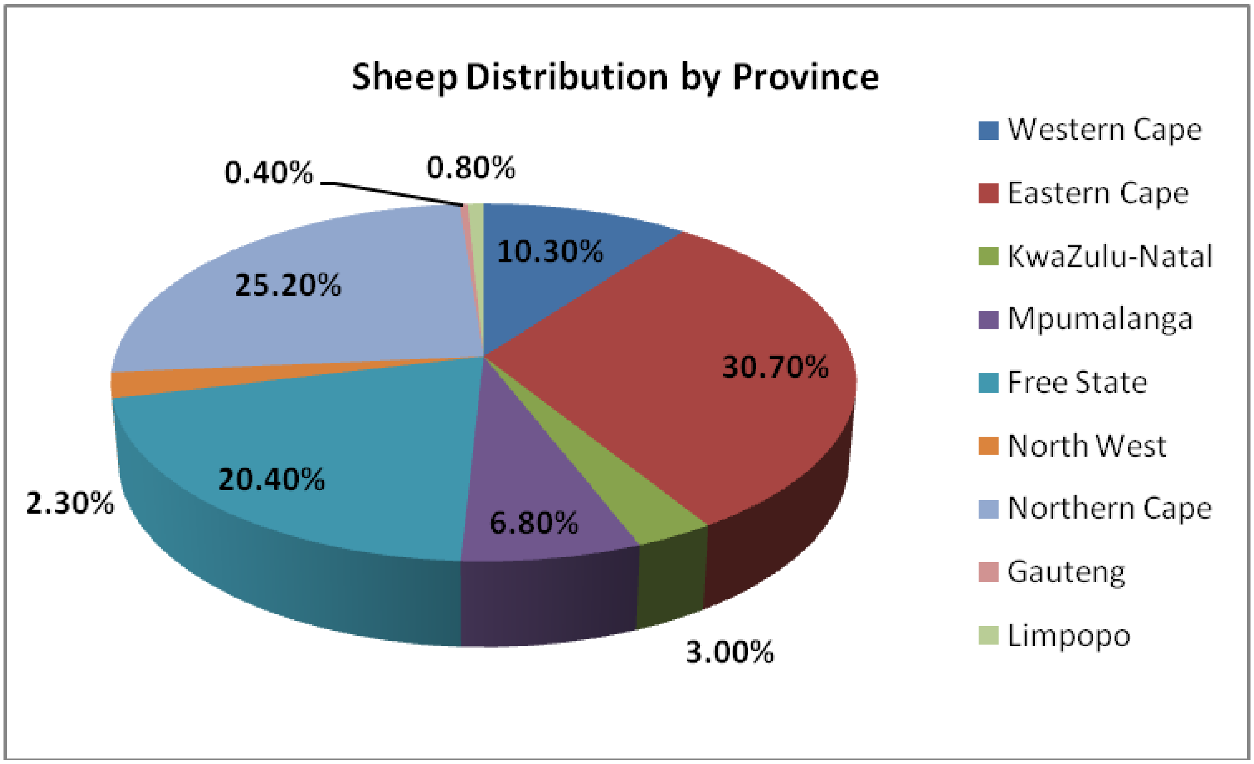


**Figure 3.2: Sheep Distribution by province** (Directorate, 2006)

The largest number of sheep (Figure 3.2) is found in the Eastern Cape (30.70%), Northern Cape (25.20%) and the Free State (20.40%). In 2006 the Free State and Northern Cape provinces contributed, together about 45.60% of the total number of sheep in South Africa. It shows the importance of central South Africa for sheep production. Sheep are kept mainly for wool and mutton production, with the Eastern Cape and Free State being the biggest and second biggest wool producing provinces respectively in South Africa during the 2011/12 season (Figure 3.3).

In 2011, the sheep and goat industry contributed in total 8.06% to the gross value of total animal production, subdivided into 5.26% for sheep and goats slaughtered and 2.80% for wool produced; while beef, pigs and poultry contributed 37%, 4.47% and 37.04% respectively (NDA, 2012).

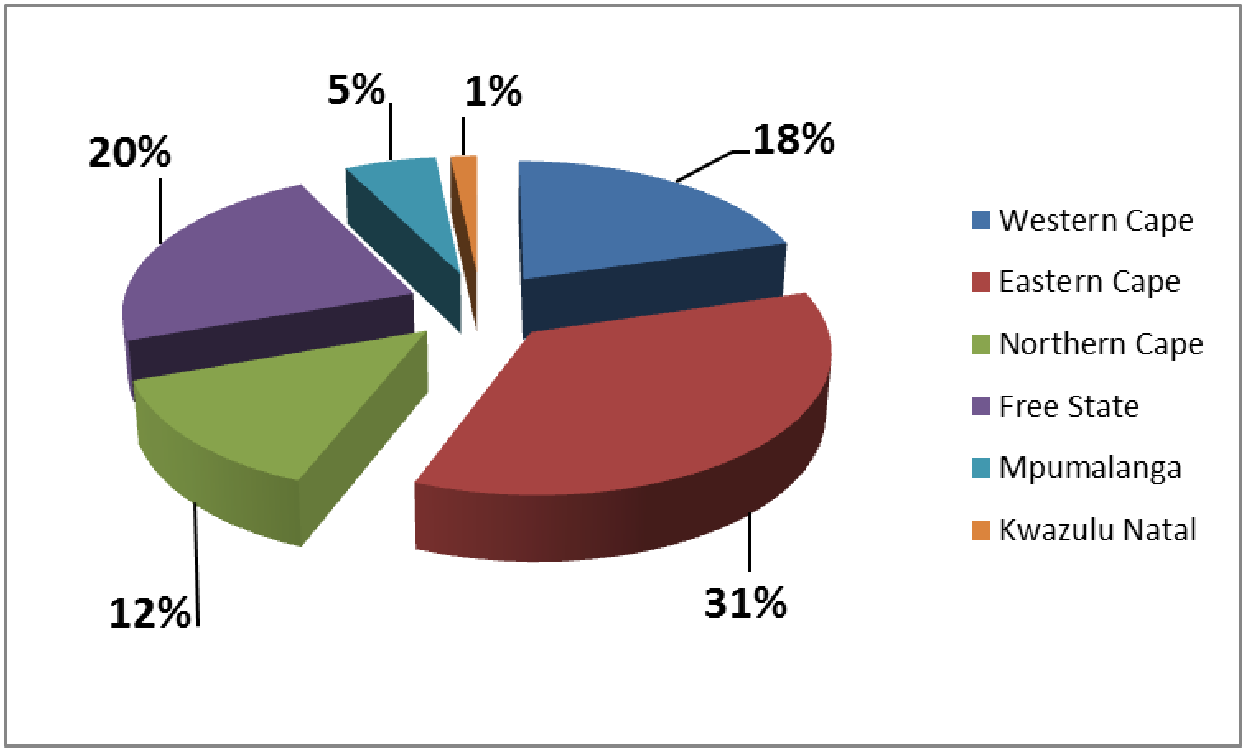


**Figure 3.3: 2011/12 Wool production per province** (NDA, 2012)

South Africa normally produces 85% of its meat requirements according to the Department of Agriculture, Forestry and Fisheries, while the rest (15%) is imported from Australia, New Zealand and the Southern African Customs Union (SACU) represented by Botswana, Lesotho, Namibia and Swaziland. Namibia (live animals) and Australia being the most important of the importers.

Figure 3.4 shows the domestic production levels and the number of sheep, lambs and goats that were imported to meet the domestic demand for consumption. There is still a long way to go before a surplus of mutton is produced in South Africa, leaving the market wide open for improvement on production levels of mutton. Over supply of mutton will not be a concern in the short term to medium term.

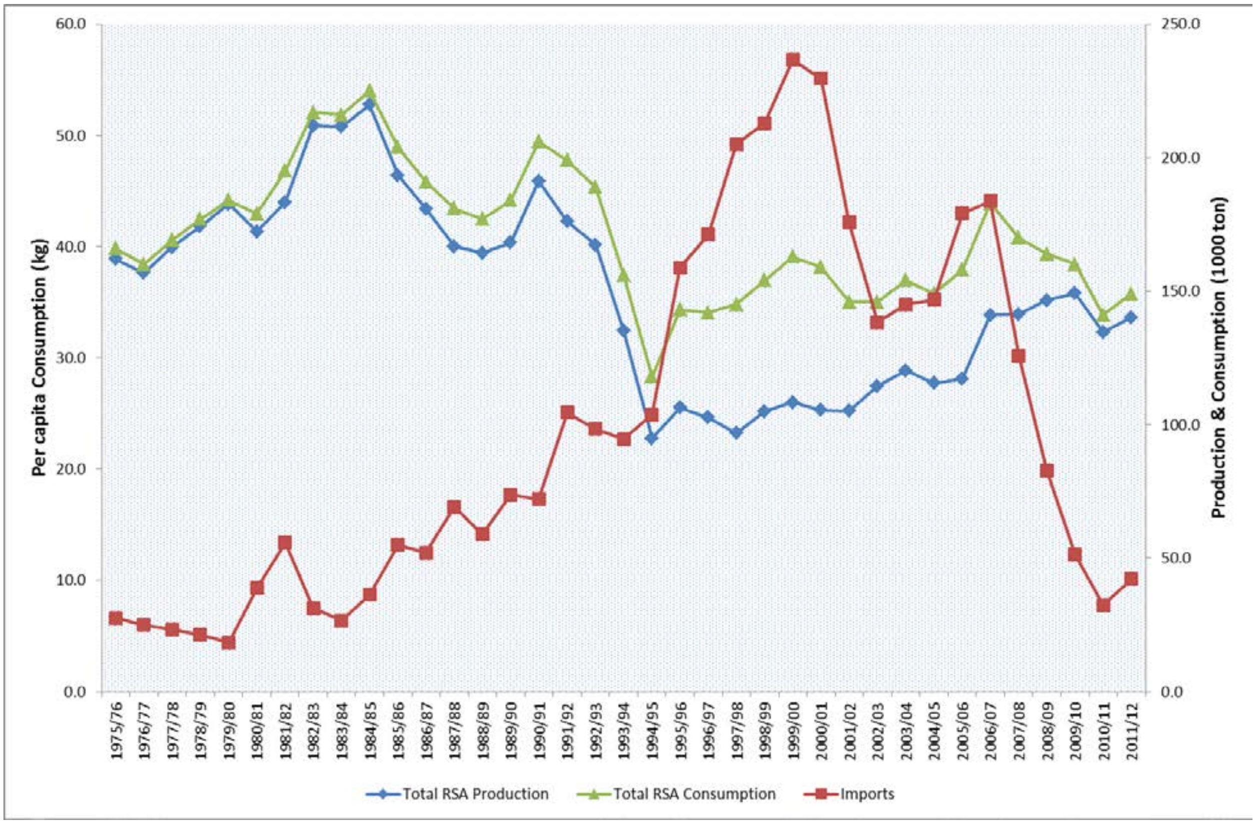


**Figure 3.4: Domestic production and imports of sheep, lamb and goats (1975 - 2011)** (NDA, 2012)

## 3.2 Sheep prices and consumption

Figure 3.5 illustrates the real average auction price of mutton, transformed real prices and the per capita consumption of mutton. The nominal price shows a strong increase in prices, but in the real price the effect of inflation is eliminated. Mutton production is therefore a very stable product to exploit when considering long term investment. Prices can unfortunately be very volatile at times but over the years, except maybe for the decrease from 1988 to 1991, was stable and showed a relatively strong increase up to 2012. The per capita consumption of mutton however decreased sharply (Figure 3.5) until 1995 when it stabilised and again declined since 2007.

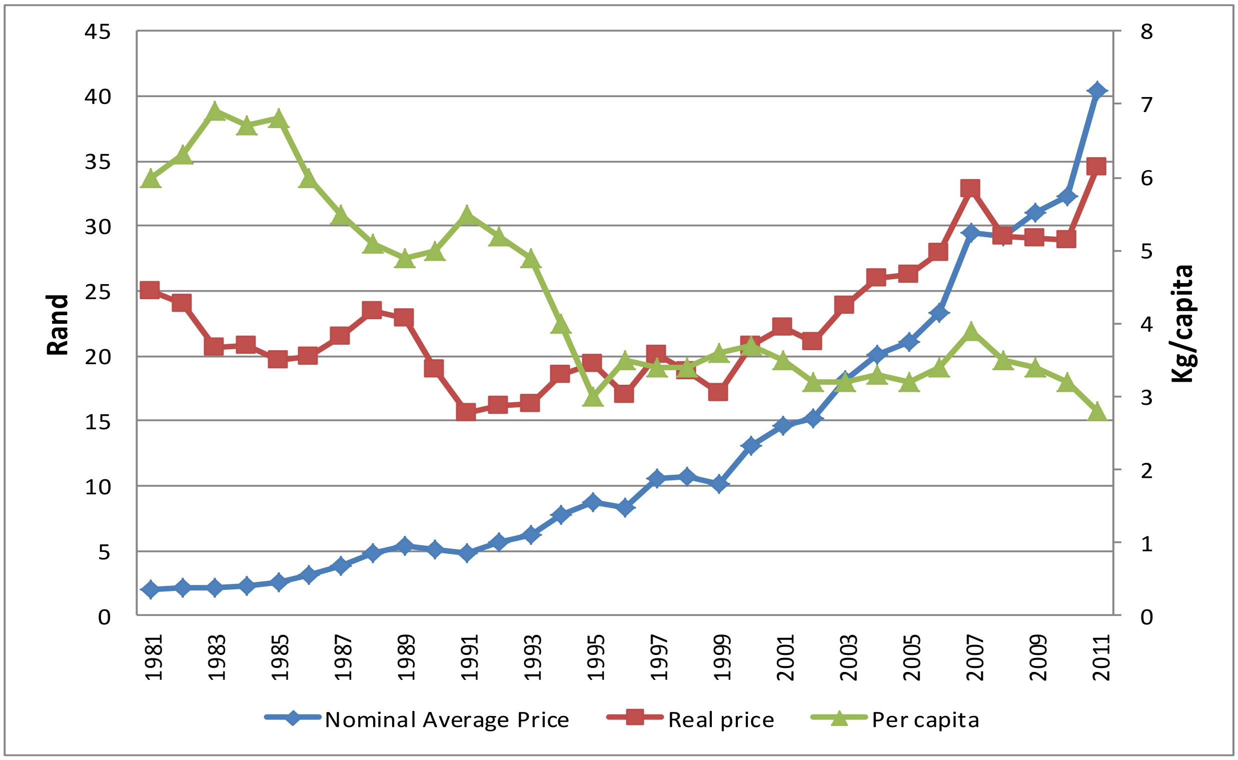


**Figure 3.5: Relation between real average auction price and per capita consumption of mutton (1981 - 2009)** (NDA, 2012).

The per capita consumption of mutton in Figure 3.5 shows a steep decline from 5.5 kg in 1990 to 3.0 kg in 1995; since then the consumption recovered to 3.8 kg per capita in 2007, but declined to 2.8 kg in 2011. The demand for mutton overall increased, because there are a lot of people that is new to the meat market due to changes in income levels. The population growth, income distribution and changes in urbanisation, will lead to a change in meat demand (Poonyth *et al.*, 2001). This could be because red meat may be considered as a luxury good. When prices increase, the producer normally changes to another protein. Mutton prices increased strongly from 2009, with record prices in 2011, presumably due to the increase in demand for the market could not supply the demand for lamb and mutton. According to the BFAP (2012) report, projections are that the decline in sheep production can be turned around with the high profit margins of sheep versus grain farming. Increased sheep production during the outlook period of the BFAP (2012) report for 2012-2021 is most likely to appear in the areas where stock theft is limited, namely the Western and Northern Cape. The world price for lamb will pull back a little from 2011 highs during 2012 and 2013 as supply from exporting countries Australia and New Zealand is expected to increase (BFAP, 2012).

On the other hand, over the last 30 years, the relative consumption share of the various meat products in Rand value terms has changed significantly. Since 1970, the share of beef, pork and mutton has decreased by 43.7%, 10.4% and 44.4% respectively. In the case of chicken, an increase of more than 46.2% compared to the total expenditure on the other three commodities has been recorded (Taljaard, 2003).

Woolled sheep produces mutton and fibre, i.e. wool. Figure 3.6 shows a steep decline in wool sales from 1981 up to around 2000 where it stabilised. This is parallel to Figure 3.1 showing the stabilisation of woolled sheep numbers around 2000. Wool sales have risen a little bit around 2005. The large decline in wool production was largely because of the strong decline in sheep numbers, crossbreeding for mutton production and problems with stock theft (Hoon, 2010).

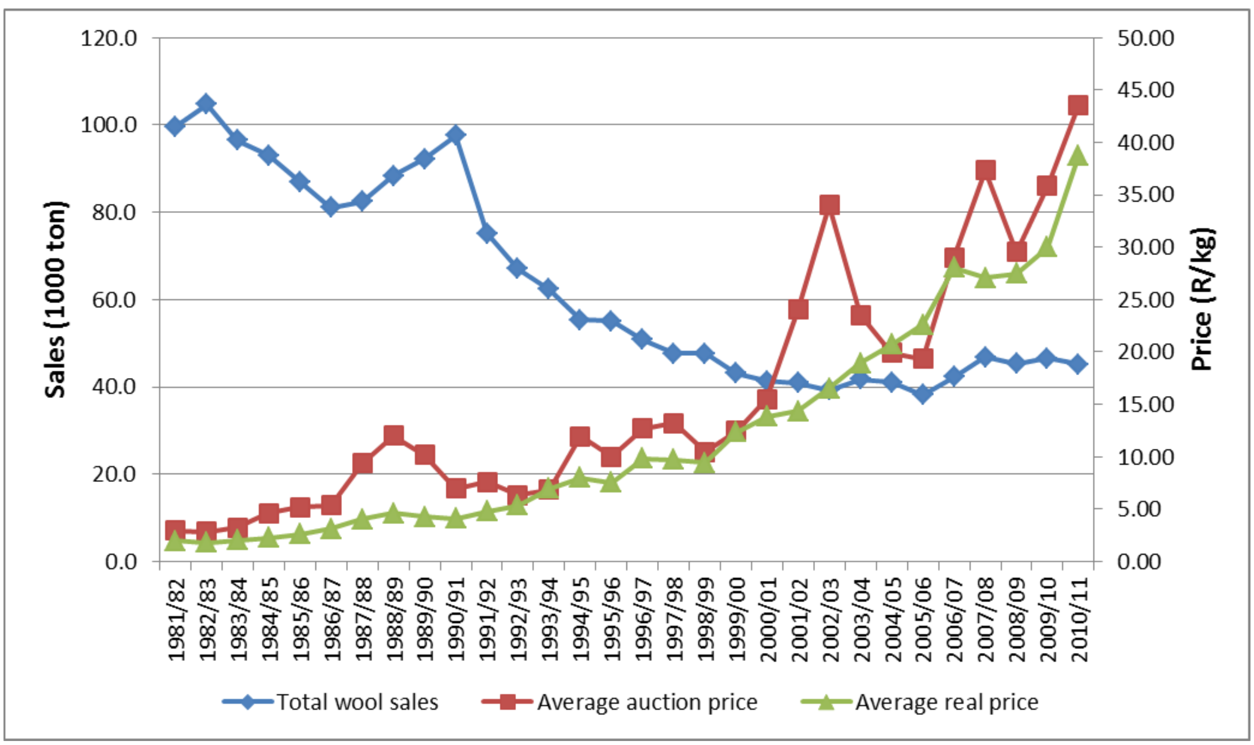


**Figure 3.6: South Africa's wool sales and prices** (NDA, 2012)

Sheep and wool are listed in the National Development Plan for the RSA, Vision 2030, developed by the National Planning Commission as enterprises with high growth potential. Wool production under intensive conditions increases dramatically with the average annual wool production of Merino ewes that can range from 9.92 kg per ewe on pastures and 10.40 kg in the feedlot. Clean yield varies from 70% to 75% under these circumstances (Bezuidenhout, 1987). The annual wool production per producing ewe according to Bezuidenhout (1987) is about 70% higher under intensive (lucerne and small grain) conditions than natural veld.

### 3.3 Merinos

South Africa was the first country outside Europe to breed Merinos since the year 1789 (De Kock, 2004). Dr. C.A. van der Merwe is of the meaning that the merino is the only sheep in the world that can produce 10 - 15% of its own live mass in clean wool" and the breeding objectives of producers changed to a dual purpose sheep with quality wool and meat production. Geyer & Van Heerden (2009) indicated that meat production is also import, without compromising wool production. Their results indicated that given the quantity and quality of wool stays the same, the higher the meat portion in the wool to meat ratio, the higher the gross margin per small stock unit.

The Merino is the highest contributor to the South African Sheep breed composition with 52.35% of all sheep being Merinos. South Africa has 71.70 percent wool sheep and 28.30 percent non-wool (Figure 3.7).

The Merino produces wool and meat and as a study done by the Australian Sheep Industry Cooperative Research Centre suggested; a dual-purpose Merino (meat-wool) enterprise offers producers flexibility against changes in commodity prices. Producers should however still pay close attention to the genetic merit of the ewes they purchase or breed (Sheep CRC, 2006). Coetzee & Malan (2008) also stresses that the specie is not the most important factor, but rather the quality and genetic potential of the specie.

According to research done in various areas of the Karoo, it was shown that there are very little differences in grazing behaviour and diet selection of different sheep breeds (Botha *et al.*, 1983; Du Toit *et al.*, 1994; Du Toit, 2000).

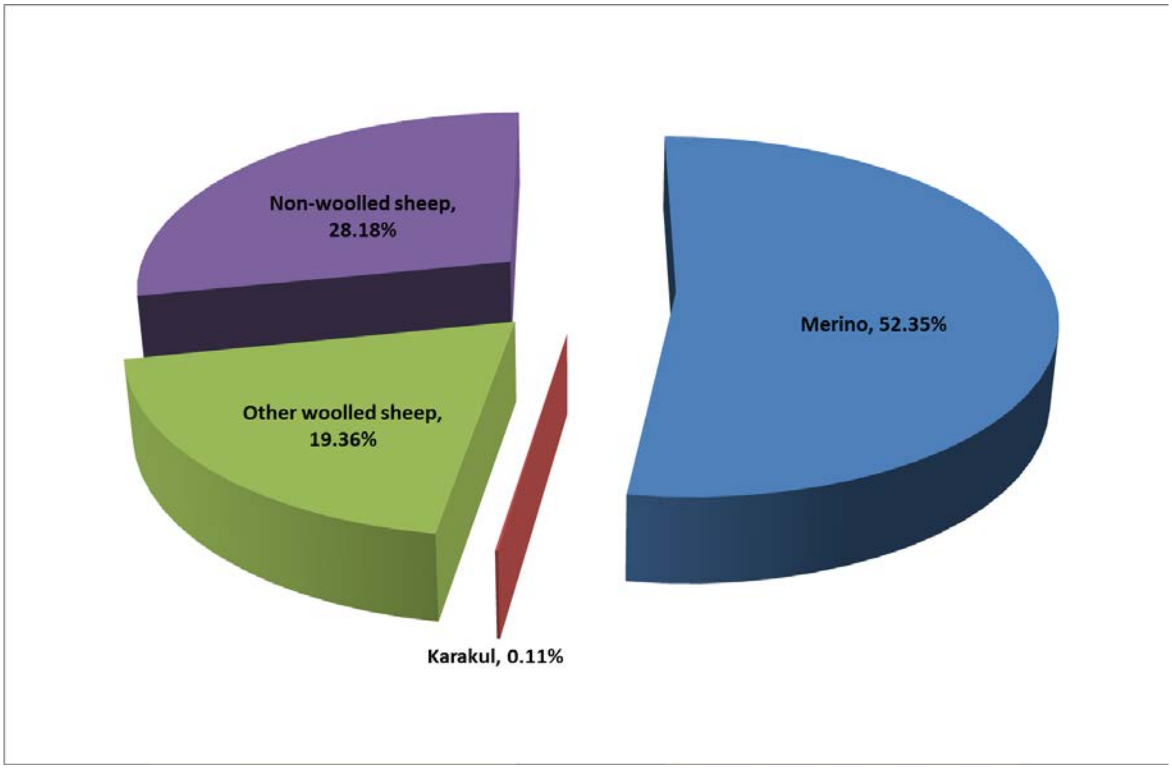


**Figure 3.7: South African sheep breed composition (NDA, 2012)**

The Merino is the specie with the smallest amount of problems with bloat; therefore it is the most reckoned sheep on planted pastures (Coetzee & Malan, 2008). Characteristics of Merinos are:

- highly fertile with good reproductive and mothering abilities;
- versatile;
- highly efficient feed converters – producing high quality mutton with even fat distribution and high quality wool; and
- with wool and mutton, the Merino gives the farmer the advantage of diversification (De Kock, 2004). Geyer & Van Heerden (2009) also emphasise the stability effect that wool and meat brings as a farming enterprise.

Roeder (2007a) questioned different producers in Montana (USA) about pasturing irrigated land with sheep. The characteristics they identified as important when looking at sheep selection are:

- multiple births;
- ability to raise at least twins; and
- good quality wool.

Selection for meat quality can be added, especially when looked at the abilities of Merinos and what is expected from them on the pastures in South Africa. The average wool/meat income ratio for Merinos is on average 30% / 70%. This underlines the importance of producing quality wool and a good quality and quantity of meat per ewe and per hectare.

## 3.4 Sheep Production Systems

The cheapest pasture and method of utilisation is direct grazing on natural veld (Louw, 2012). A challenge for pastoral farming, with biological, physical and economic factors, is to be profitable and sustainable. Beukes *et al.* (2008) defined it as maintaining the health of the animals and pastures and to minimising environmental effects. According to Dickinson, Hyam & Breytenbach (1990) there is a positive correlation between veld condition and profitability. One of the main profit drivers of sheep farming are the kilograms of wool and mutton produced per hectare (Warn *et al*., 2006). This is affected by nutrition, management and selection (Coetzee, 2010).

The choice of production system is critical as the system will affect the profitability and the stability of the enterprise (Smith, 1999). Smith (1999) listed five important factors to consider when choosing a sheep production system:

- **markets** (compare profitability of lamb, mutton and wool, examine future market trends),

- **efficiency of production** (intensive systems require high lambing percentages to be profitable compared to extensive systems. The efficiency of production will depend on the level of management),
- **feed available** (intensive systems can be profitable when climate conditions is favourable, otherwise the system must be extensive),
- **veld type**, and
- **farm carrying capacity** (a small farm might need an intensive system with high lambing percentage to be profitable).

### 3.4.1 Extensive Sheep Production: Rangeland only

South Africa is according to PGSA (2009) & Anonym D (2009) mainly suitable for extensive livestock production with approximately 80% of agricultural land in South Africa being used for extensive livestock production. Production must be a low cost process (Nel, 1980 & Duras, 2008) in an area with low grazing capacity. The summers are very hot, with the winters very cold. Ewes in extensive areas are expected to produce at least one lamb per year per ewe (Nel, 1980 & Calldo *et al.*, undated). Most of the ewes lamb in autumn. Lambs are usually sold to abattoirs as soon as they reached a body weight of 30-40 kg (Duras, 2008). Minimum health care is necessary compared to irrigated pastures. The extensive sheep production systems is the most vulnerable to the risks or challenges of sheep production such as predators and stock theft as it was sited in Botha (2009), Van Niekerk (2010), Nel *et al.*, 2010, Kingwill (2011) & Wessels, 2011.

### 3.4.2 Semi-extensive Sheep Production: Natural veld and irrigated pastures

Fodder can sometimes be a restriction, therefore it is important that health management is good to maximise output (Calldo *et al.*, undated). This system is an extensive sheep production system using supplementary feeds such irrigated pastures to carry the ewes through winter or as strategic fodder during lambing season. These pastures are most of the time annual and needs establishment every year (Smith, 2004). Smith's (1999) guideline for a semi-extensive sheep production system use the breeding of Merino ewes mainly on veld with feed supplements in winter and mated in spring. The ewes and lambs run on pastures during winter and the lambs are sold from the veld in February (Smith, 1999).

### 3.4.3 Intensive Sheep Production: Irrigated pastures only

The system uses irrigated pastures for sheep production. Pasture- and health management are very important in these systems (Coetzee, 2010). Sheep are kept at very high stocking rates on these permanent pastures.

The system must be focussed on maximising production and reproduction (Calldo *et al.*, undated). According to Calldo *et al.* (undated) the weaning percentage of these systems must not be below 120%. Annual wool production per ewe on irrigated pastures is about 70% higher than on natural veld (Bezuidenhout, 1987). Ram selection in terms of wool traits is thus very important, because the high quality pasture not only produces more wool, but also strengthens the fibre diameter of the wool (Calldo *et al.*, undated). Pienaar (2010) uses rams with a two micron finer fibre diameter to genetically control the flock's fibre diameter. Improved pastures can reduce wool faults and good maintenance of wool fibre diameter and staple strength (Moore G, Sanford P & Wiley (2006). Hall *et al.* (1997) showed that the improvement of pasture will support increases in wool returns due to quality wool production.

### 3.4.4 Intensive Sheep Production: Silage system

The use of silage as food supply for sheep is a fairly new concept in South Africa with not many farmers using this production system. It is also mostly used in areas with irrigation possibilities. Literature on silage for sheep in South Africa could not be found. One sheep production system of the study used silage to produce mutton and wool.

Silage is made, amongst others, from maize and peas. It can be stored away after harvesting and utilised as needed (LPP, 2006). The sheep can be kept in holding facilities and don't need big surfaces because they are kraal based. They need to be fed everyday from the silage bunkers (LPP, 2006).

The main disadvantage of silage is that it needs higher levels of labour and time (Hutton, 2008). The question of "what will the return on investment be for these high capital requirements of the silage sheep production system" also remains. Management is of the outmost importance for this high capital system, as for every sheep production system!

According to Roeder (2007b), the three most important priorities when looking at a sheep production system are intensive grazing rotation first, proper water management second and fertilisation third. However, this is only in terms of fodder production. According to Coetzee (2010) health it is very important, especially on irrigated pastures where the concentration of animals is very high with internal parasites being a huge problem. Health management thus became a fourth factor to consider. If there is a disease outbreak and health management is not up to date it could be a huge blow to the system.

## 3.5 Pastures

### 3.5.1 Irrigation of pastures

Crops differ in their water needs therefore it is important that the feeding program fits into the available irrigation water supply (Bezuidenhout, 1987). The use of irrigation eliminates water as the uncertain input for pasture production. The rule of thumb is that irrigation will increase dry matter (DM) yield with up to 40%, however it comes with a cost (Florence, 2002). According to Breytenbach *et al.* (1996) it is possible that the cost of electricity for pasture irrigation such as *Lolium perenne* can be between 10-18% of the total variable costs.

There are important implications in terms of advice for irrigation farming according to Breytenbach *et al.* (1996). Firstly, there must be economical use of the quantity of irrigation water through crop planning and scheduling. Secondly, there must be an economical balans between capital layout and the annual operating cost of the irrigation system's design. The conclusion therefore is to choose the electricity tariff, considering design and quantity of water, in order to minimise the cost of electricity.

It is important to notice that irrigation does not replace good pasture management (Archibald *et al.*, 2007). Irrigation may be applied to pastures as surface or as overhead irrigation. The production systems in this study used centre pivots (which were overhead irrigation). A dragline system was used for a small area in the silage system, while the remainder were pivots.

Maintaining soil moisture content is a critical management requirement for optimum production and botanical composition of grass-clover pastures. Low soil moisture levels together with high temperatures (>30ºC) reduce clover growth. Soil moisture management depends on rooting depth of the pasture species, the growth rate of the plants, soil type and the availability of water (Botha, 2009). The pasture must be watered immediately following grazing (Roeder, 2007). As in previous studies, Warren *et al.* (1986) found that moist soils are more susceptible to compaction than dry soils. Therefore it is important that wet pasture should not be grazed while being irrigated or until the soil have dried out (Smith, 2007 & Pienaar, 2010).

Sometimes flood irrigation of pastures is used (Roeder, 2007) for systems where sheep utilise the pasture only for a period of the year. One disadvantage of flood irrigation is to control water flow and distribution, thus irrigation efficiency is low (Donaldson, 2001). Flood irrigation also has a more negative impact on soil compaction than sprinkler irrigation. One disadvantage of sprinkler irrigation systems is the large capital outlay and running costs when compared to flood irrigation.

The main advantages of sprinkler irrigation are that it can be used:

- where the water source is weak and no storage facilities are available
- on shallow soils and steep beds
- it is ideal for pasture establishment with light irrigation periods. Insufficient watering after planting may be the most common mistake by farmers (Smith, 2007) and
- the relatively light frequent irrigations are more efficient and do not compact soils or eliminate soil air (oxygen) as much as heavy irrigation (Donaldson, 2001)

The high capital outlay and the intensiveness of these production systems makes it very important to remember that the very high yields of irrigated pastures must be effectively utilised in order to cover the high costs involved (Donaldson, 2001). Van Pletzen *et al.* (2011) give a guideline cost of R32 380 per hectare. It will be wise to use expert advice and support when deciding on a pasture (Smith, 2007) and an irrigation system.

### 3.5.2 Management of pastures

The correct management of pastures is of the utmost importance. Utilisation is the most important factor in the calculation of profitability of pastures (Du Toit, 2008 & Fair, 1989). While it takes skill to get a pasture well established it requires even more skill to make sustained profits out of it (Fair, 1989). According to Malan (2009) a livestock farmer is actually a farmer that farms with grasses and shrubs, the animals are simply the factories that convert the plants into money. Pienaar (2010) argue that pasture is the farm's fuel, and should be turned into a marketable product in the most productive way. The principle in both opinions is that the pasture begins the value-chain and the correct use of it therefore cannot be over emphasised. Smith (2007) also states that "I'm really more farmer than rancher – a grass farmer". Therefore, if the pastures are damaged or are not manage correctly, it will have a negative impact on the profitability of the system. A study by Curtis & O'Brien (1994) in Australia found that farms with good management had the highest profits and, seventy too eighty percent of the pastures grown by these farms were consumed.

The basic principle with pasture utilisation is to allow the pasture to grow until a certain stage at which it can be utilised. It should be allowed to rest in order to recover and rebuild its reserves (Fair, 1989, Scheepers, 2005, Archibald *et al.*, 2007).

It is very important to understand the balance between forage quality and – quantity, it is often the case that the higher the quantity, the lower the quality. A quote of a Dr. Sandles of Australia in Kirkman (2011) demonstrates the importance of pasture management: "Managing pasture quality is the issue that should consume dairy farmers from daylight to dark".

Figure 3.8 demonstrates the three phases of plant maturity. There is clearly a negative correlation between quality and quantity, i.e. protein and palatability versus lignin. The quality (protein and palatability) decreases as the plant reach maturity (higher in lignin). The pastures should be allowed to recover and produce enough plant material but there is a certain point at which the quality starts to decrease (Du Toit, 2008). Optimum grazing occurs at point Z in Figure 3.8 where the protein and lignin lines cut each other.

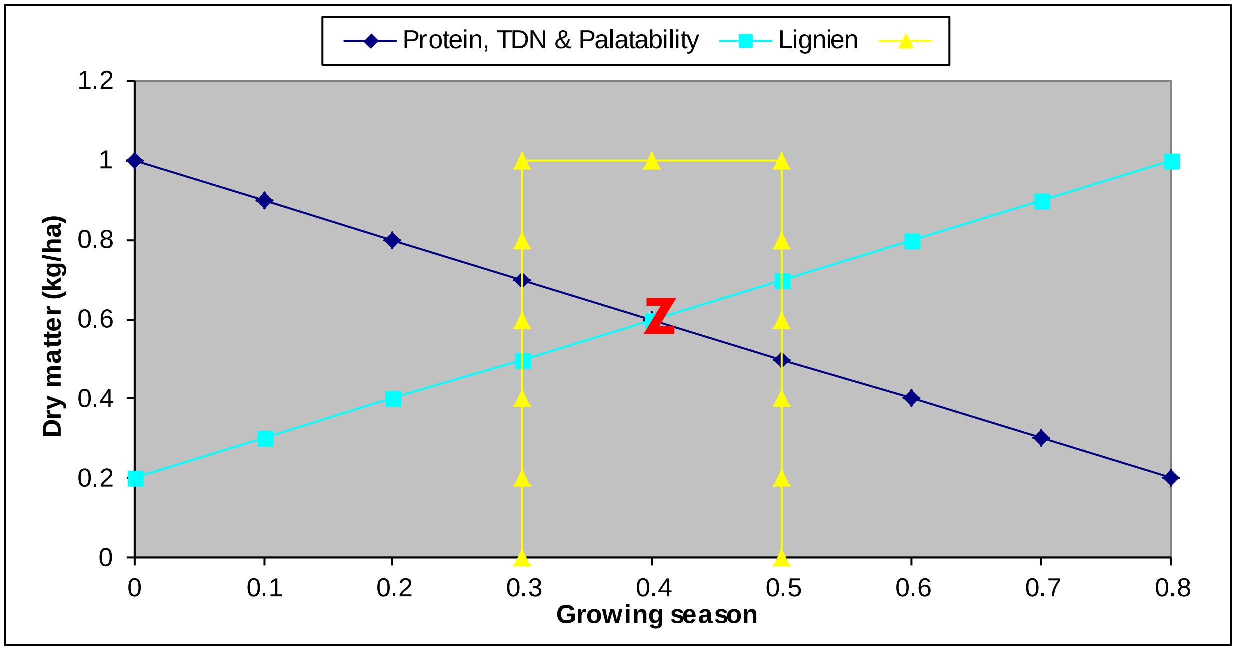


**Figure 3.8: Phases of plant maturity (**Bartlett, 2004)

Cockrell (undated) and Roeder (2007b) described the following rule of thumb: Graze half and leave half; and when pasture growth is slow, slow down the rotation (i.e. graze faster in spring and slowdown in summer and winter). Bezuidenhout (1984) states the advantages of grazing *Medicago sativa* on the 15-20cm growth stadium as the following:

- higher nutritive value
- less selective grazing
- less internal parasites
- higher average body weights and
- higher wool production

The persistence of clovers in grass-clover pastures is very important, because the production potential of a perennial grass-clover pasture depends mainly on the grass-clover ratio. According to Martin (1960) a clover content of 30-50% is needed for an optimum quantity and quality of herbage. A good management system is based on the optimum production (kg DM/ha/day) of high quality, palatable dry matter and the highest possible animal intake (kg DM/animal/day).

Pasture trials at Outeniqua Experimental Farm showed that a hectare of grass-clover pasture can produce between 20 and 24 tonnes of dry matter (DM) a year (Botha & Oberholzer, 1997), but 32% of this feed was going to waste. Optimum production and optimum use is therefore of the utmost importance when looking at pasture management.

Two principles, important when studying pasture management are:

- Inputs must be provided in order to maintain or increase production and
- The pasture must be used at the correct (see point Z in Figure 3.8) stage in order to get the maximum economic advantage of the pasture.

The biggest problem with fodder flow planning is the “winter feed gap” which occurs in the late autumn and winter months. Winter gap refers to the cool season where the cultivated pasture shows lower productivity. The farmer must balance the supply of forage with the animals demand. Forage supply can be extended and increased through different species, fertilisation, irrigation, and lastly grazing (Roeder, 2007b). The seasonal growth patterns of certain pastures like *Medicago sativa*, calls for an alternative crop to fill the winter feed gap months. Examples are the use of small grain or *Lolium perenne* suited for the winter months (Bezuidenhout, 1987). Labuschagne (2005 A) suggests that the effect of the winter feed gap can successfully be addressed through the application of Nitrogen (N) in the cool season in the winter rain areas of the Western Cape.

### 3.5.3 Choosing the correct species and mixtures

Pasture species must be chosen with great responsibility because it will be a long term investment. The chosen forage should fit the situation (Smith, 2007). It is also important to plan before sowing a piece of land because previous activities like the use of herbicides on the previous year's crops could have an impact on the sustainability of newly sown pastures (Smith, 2007).

A combination of grass and clover works well. The grass gives quantity and die clover quality, therefore the mix has a good balance. Different grasses get included because of different functions. For example, Tall Fescues (*Festuca arundinaceae*) have a higher late spring and summer production compared to Perennial Ryegrass (*Lolium perenne*). It is however important to know each cultivar, because they require different management. Tall Fescues (*Festuca arundinaceae*) for instance become unpalatable if not grazed short in a short rotation system (24-28 days cycle) (Botha & Oberholzer, 1997). Some pastures can be utilised throughout the year like *Medicago sativa*-grass mixtures and grass-clover mixtures (Bezuidenhout, 1987).

An example of a grass-clover mixture that was used in 3.4.2 Intensive sheep production with pastures under irrigation: *Medicago sativa* (Lucerne) and a seven in one (7 in 1) pasture mix, consisting of:

- *Lolium multiflorum* (Annual ryegrass)
- *Lolium perenne* (Perennial ryegrass)
- *Phalaris aquatic* (Canary Islands grass)
- *Dactylis glomerata* (Cocksfoot grass)
- *Festuca arundinaceae* (Tall fescue)
- *Trifolium repens* (white clover) and
- *Trifolium pratense* (red clover) (Archibald *et al*., 2007) where established.

Acquire expert advice when choosing pasture varieties for a farm, so that the best varieties for the farm are obtained, because differences occur between farms as well. There are even fields on one farm that can differ. The following factors all need to be considered when looking for the right variety (Roeder, 2007):

- adaptable to the soil type and pH
- fertiliser requirements
- longevity
- palatability for sheep
- bloat potential must be low
- re-growth potential
- rest period required
- season of growth and
- ease of establishment

**3.5.3.1 Different growth periods**

The fodder flow of each farm is different; therefore their needs would not be the same. Some production systems are dependent on irrigated pastures for the whole year using pastures like grass:clover mixtures (Nel *et al*., 2010; Pienaar, 2010 & Wessels, 2011), where other production systems only uses an annual pasture to bridge the cap in the year's fodder flow program or at strategic times during the production year (Smith, 2004 & Wessels, 2011).

**3.5.3.1.1 Annual pastures**

Annual pastures can be part of a fodder flow program or maybe a strategic pasture to use during lambing season (Pannar, undated). Irrigated pastures like *Lolium multiflorum* (Annual ryegrass) and *Hordeum vulgare* (Barley) in the semi-extensive sheep production system in 3.4.2 were used as part of the fodder flow program. Examples of annual pastures are *Lolium multiflorum* (Annual ryegrass), *Avena sativa* (Oats), and

*Hordeum vulgare* (Barley) (Archibald *et al*., 2007 & Snyman, 2012). The advantage of annual pastures according to Wessels (2011) is the flexibility it gives when product prices and market conditions change.

#### 3.5.3.1.2 Perennial pastures

Perennial pastures normally takes longer to establish than annual pastures (Wessels, 2011) and in some cases only reach its full production from year two (Pannar, undated). Examples of such crops used in pastures, like in the sheep production system using irrigated pastures in 3.4.3 are *Medicago sativa* (Lucerne), *Lolium perenne* (Perennial ryegrass), *Phalaris aquatic* (Canary Islands grass), *Dactylis glomerata* (Cocksfoot grass), *Festuca arundinaceae* (Tall fescue), *Trifolium repens* (white clover) and *Trifolium pratense* (red clover).

Perennial pastures have higher costs of establishment than annual pastures, but tend to have a longer growing season (Feedbase, 2007). Feedbase (2007) further debates that perennial pasture's risk of establishment failure is greater, but their ability to produce "out-of-season" forage, can level out the winter feed gap.

### 3.5.4 Establishing pastures

#### 3.5.4.1 Plant spacing

According to Bartholomew *et al*. (1991), a row planted pasture has certain advantages over broadcast pastures. The advantages include: reduced dry matter losses through plant decay and reduced damage to plants through trampling by stock. Trampling by stock can further be limited through management practices. Bezuidenhout (1987) also found that the lower utilisation of *Medicago sativa* at a 10% flowering stage can be attributed to the large amount of material being trampled.

### 3.5.4.2 Fertilisation

The correct use of fertilisers can extend the grazing season of pastures. It will not only grow more dry material (DM) per hectare, but the pasture will also be higher in protein and energy. It will be more palatable, which will improve DM intake, with the end result improved livestock performance (Cockrell, undated). Cockrell (undated) also found that well fertilised pastures are more drought resistant and extends the grazing season.

There are certain questions to be asked when looking at the fertilisation of pastures. The decisions made based on the answers from these questions, will have an influence on the profitability of the pastures. The questions according to Cuomo (1999) are:

1. SHOULD you fertilise,
2. WHEN should you fertilise,
3. WHERE should you fertilise,
4. The SOURCE of fertilisation, and
5. How MUCH to use.

The first step in deciding to fertilise is to get a soil analysis. Recommendations can then be made to what degree of fertilisation is necessary (Cuomo, 1999). If phosphorus (P) and potassium (K) are limiting, the nitrogen (N) applications will be less effective. An overall planned fertilisation program must be followed according to the soil analysis. The most important fertilisers to apply are nitrogen (N) and phosphorus.

The pastures are planted with the necessary fertiliser needs according to the needs of the soil analysis. Applying all N at once like most maize farmers do is not a good idea, because N is lost over time through leaching. A small application of N in early spring can be effective in getting growth started as the weather warms up (Paine, 2001). In the growing season N should be applied in small amounts for optimal use. Pannar (undated) recommended that the pastures needs about 220 kg nitrogen (N) per hectare (ha) throughout the season as a guideline. Botha (2012) recommended 35-40 kg nitrogen (N) per hectare for irrigated ryegrass after each grazing (not less than 30 days). Wessels (2011) also applied between 200-250 kg nitrogen (N) per ha in 4-5 applications. The principle is clear, not to apply all fertiliser in one application.

Moderate levels of N applied in autumn, will:

- improve the resistance to cold
- improve dry matter yield and quality and
- provide a residual response for early spring growth (Bartholomew *et al*. 1991)

Nitrogen can be applied to pastures in several forms, namely fertiliser, animal manure or growing legumes. The fertiliser source and its effectiveness can be determined by the pasture used (the presence of legumes or not) and management system. However, it is proven that legumes can be an excellent source of N to pastures. Labuschagne (2005 A) highlights three advantages of clovers. Firstly, *Trifolium* spp. (Clover) improves the quality of the pasture resulting in an increase of milk and wool production. Secondly, a legume is capable of fixing large quantities of atmospheric nitrogen and through recycling this N becomes available for absorption by the ryegrass fraction (Martin, 1960). McKenzie *et al.* (1999) reported that symbiotic nitrogen bonding provides only enough N for 70% of the potential DM to be produced. Thirdly, it improves seasonal distribution of the forage by being more productive later in the year than the companion crop (Sleugh *et al.,* 2000). Nitrogen application gives a competitive advantage to *Lolium* spp. (Ryegrass) over *Trifolium* species.

Management is important when using animal manure. According to Scheepers (2005) it is not cost-effective to buy animal manure and transport it to the farm, but through grazing the animal directly “applies” its manure on to the pasture. Cuomo (1999) states in his study that N fertilization of pastures through manure and urine is often not evenly distributed. It can be corrected through the use of a grazing system where grazing is for shorter periods but with a higher stocking density. If pastures run out of nitrogen it will show deficiency symptoms and will change from a greenish colour to yellow. The areas around the manure piles will however form green rings, showing that they provide nitrogen to the plants.

The use of nitrogen must always be considered in balance with the pasture. Nitrogen fertilisation tends to favour grasses over legumes and can therefore affect the botanical composition. However, when grazed, legumes generally can compete with grasses, even under relatively high N rates (Cuomo, 1999). The negative effect of nitrogen fertilisation on the *Trifolium* spp. can be minimised by knowing the temperature characteristics of species. The use of 50 kg N/ha from April to October will increase DM production with the lowest negative influence on the *Trifolium* spp. Nitrogen can be applied every year, and it is worthwhile to apply phosphorus every other year to stimulate *Trifolium* spp. growth.

<u>High fertilisation cost can be managed by the factors such as:</u>

- take annual soil samples and keep a record of results (Pannar, undated)
- strategic applications of nitrogen (N) during the active growth period of grasses are important. High levels of N applied at the wrong time are uneconomical and can change the composition of the pasture (Labuschagne, 2005 B). Gerrish (2006) highlighted the fact that timing of nitrogen (N) application and grazing management have a lot to do with the profitability of nitrogen (N) fertilisation
- fertilise N at recommended amounts according to the pasture species and expected yield (Archibald *et al*., 2007)
- irrigation scheduling is important otherwise one can expect that valuable soil nutrients will be leached (Broner, 2005) and
- urea as an N fertiliser is ineffective if applied on wet grass pastures in windy conditions

Grass-clover pastures takes between 2-5 months to establish before it is available for use. According to Pienaar (2010) such pastures can be utilised with 15 ewes per hectare after 5 months, increased to 20 ewes 6 months later and up to 30 ewes per hectare a further 6 months later. By then the pasture had time to establish a good root system and is ready to be grazed permanently with a well-planned grazing system. Pannar (undated) supports the principle that perennial pastures takes about 2 months to establish and reach its full production only from the second year. Heavy grazing shortly after establishment should be avoided. Bezuidenhout (1987) state that some pastures like grass-clover mixes and lucerne grass mixes can be grazed the whole year with an appropriate grazing system. However, *Medicago sativa* can only be grazed in summer (Bezuidenhout, 1987), with surplus production baled and used for the rest of the year (Bezuidenhout, 1984). The irrigated pastures production system used a perennial grass:clover mix being able to supply (at different levels through the production year) fodder for the whole year.

### **3.5.5 Utilising (grazing) of pastures**

The cheapest way of utilising pastures is through grazing (Archibald *et al*., 2007), but it is not a matter of just grazing. There are many factors to take into consideration when deciding on a management system. Principles to consider when deciding on a grazing system for pasture management, includes the following:

- pasture should be allowed to rest and grow (recover) (Du Toit, 2008)
- pasture must be utilised at the correct time otherwise it will lose its quality (Du Toit, 2008)
- understand each pasture variety and its characteristics because it will have an influence the management system to use. For example, white clover (*Trifolium* repens) grows lower to the ground and therefore the grasses should not be allowed to overshadow it because it will slow down the clover's growth
- pasture should not be grazed when wet, it will cause the ground to harden and form a hard cover which will have a negative impact on ground structure and eventually pasture quality. Rather move the sheep into a veld camp on the side of the pasture to prevent compaction (Bezuidenhout, 1987)
- during the winter frost should be allowed to melt down before the animals are allowed on the pasture (Pienaar, 2010)
- grazing periods of five to seven days per camp is recommendable. It also fits in with the irrigation management of *Medicago sativa* and can be used when

planning to break the basic length of an internal parasite's lifecycle of 21 days (Bezuidenhout, 1987 & Maxwell, 2008)

The necessity and use of functional fodder flow planning cannot be over emphasised, because it affects the efficiency of animal production and in the end financial success (Nell *et al.*, 2011).

**<u>3.5.5.1 Management systems</u>**

According to (Southey, 2011) the recipes to sound pasture management include planning the irrigated pasture's mixture, its centre-pivot fencing system, anti-bloat licks, grazing systems and kraal designs. Irrigated pastures are a high quality fodder and needs to be management to the finest detail. It will be better to remove the sheep from the pastures during the night to prevent wastage by trampling. The ideal situation according to Pienaar (2010) and Coetzee (2010) is to have a veld camp alongside the pasture where the sheep can be fed licks and where they can sleep, with the notion that they can move freely on and of the pastures as they like.

The sheep production systems in the study all used rotational or a form of rotational grazing, whether it is irrigated pastures or natural veld. Rotational grazing is when a number of camps are being allocated to a group of animals. The enclosures are then grazed successively in rotation so that not all of them are grazed simultaneously (Tainton, 1999). Bezuidenhout (1987) refers to a lot of research (Robards & Peart, 1967; Thompson, Sheridan & Hamilton, 1976) where the results are consistent with previous research that showed that a rotational grazing system is the best way to utilise and maintain *Medicago sativa*.

Strip grazing is a rotational grazing system that uses the principle where a new area of pasture is allocated to the sheep for a certain time interval before they are moved to the next area. It allows for more:

- efficient utilisation of the herbage
- effective rationing of the feed supply and
- animal manure is also more constantly distributed if it is used as fertiliser (Bartholomew *et al*. 1991)

However, it requires more management, labour and material (fences and water supply) for implementation (Bartholomew *et al*., 1991 & Arceneau, undated). Grazing can be controlled by subdividing the pasture with a temporary electric fence into as many camps as needed for the chosen grazing system (used in 3.3.3. Intensive Sheep Production: Irrigated pastures).

## 3.6 Silage

Silage is the product of controlled fermentation of green fodder retaining high moisture content. It is popular forage for ruminant animals because of its high digestibility and energy levels (Howell & Martz, 1993). The process of making silage is called ensiling (LPP, 2006).

Four main advantages of silage according to LPP (2006):

- build up feed reserve
- a feed supplement to increase productivity of animals
- utilise excess growth of pasture for better management and utilisation and
- to store and enable extended use of potentially unstable material

It is however noticeable that silage is only useful if it is of good quality, i.e. well preserved and of high digestibility and protein content. Poorly made silage can cause health problems in animals and low intake levels Coblentz (undated).

LPP (2006) argues that the quality of the silage depends on the (1) feeding value of the material ensiled, (2) the fermentation products present, and (3) the types of acids and the amount of ammonia present. Coblentz (undated) adds that ensiling must start with high quality forage to achieve high quality silage. LPP (2006) also suggests the following principles for high quality silage:

- the material must have a high nutritive value
- the forage must not be contaminated with soil
- the forage should be chopped into small pieces
- it is necessary to expel the maximum amount of air before closing the silo
- collection and processing of the material should be done in the shortest possible time and
- during feeding, the area exposed should be as small as possible

Advantages of silage

- the crop can be harvested in almost all weather conditions
- fewer harvesting losses, thus more nutrients are harvested per hectare than hay for example
- it offers a practical solution for hail damaged, frozen or otherwise damaged crops (Hutton, 2008)

The major disadvantages of silage could be the high levels of labour and time needed (Hutton, 2008).

Lauer (2009) identified the following key management practices in making maize silage production and quality profitable:

- hybrid selection;
- harvest at the right maturity and moisture content;
- remember that a trade-off exists between yield and quality for management decisions;
- early planting date;
- slightly higher plant populations than what is normally used for grain production;

- pest control;
- adequate soil fertility – predicted by soil sampling;
- narrower row spacing increases yield;
- cut at right height, chop at right length, and consider processing;
- fill silo rapidly, pack well and cover securely.

The question when deciding to make silage is how much silage is required? That will depend on the number and type of livestock, length of feeding period, percentage silage of the full ration and material resources (such as labour, equipment, etc.) available.

**3.6.1 Basic method of Silage making** (Howell & Martz, 1993, Jennings, 2011 and LPP, 2006):

| | |
|---|---|
| Making a "silo" | A pit in the ground, trench or tower or a plastic bag where the green fodder is stored as silage. |
| Harvesting of crops | The crops should contain about 30-35% dry matter at the time of ensiling. The quality of the silage depends on the stage of harvesting. |
| Chopping the crop | Chop the crop into small pieces. It makes it easy to compact and to remove the air between the pieces. |
| Filling the silo (Compaction & Sealing) | The material gets filled layer by layer into the container. The crop needs to be compacted all the time in order to remove all the air. |
| Feeding the silage to livestock | Silage can be fed as a source of roughage either on its own or with other feed sources. |

Silage making depends on the growing conditions and the availability of the forage to be ensiled. The ideal situation would be that the silage production process, from harvesting up to covering the silo, should be within 24 hours, reducing the risk of weather damages to the crops (Coblentz, undated).

Nutrient losses usually occur during the ensiling process. The loss will depend on the effort to exclude air. Compaction must be very good and all the air must be excluded to prevent mould forming. It is common for mould to form around silo doors and edges of bunker silos, but with increased intensity in the silage preparation this can be limited (Howell & Martz, 1993). LPP (2006) suggests that the silage should be stored in more than one silo.

### 3.6.2 Plant species suitable for silage making

Maize is possible one of the best varieties to use for silage. Other crops suitable for silage are oats, sorghum and pearl millet (Landman, 2010). A variety that matures slightly later than one harvested for grain is often the most satisfactory for silage. A maize hybrid that is a high grain yielder will more often than not be a top silage producer. Many silage varieties are simply tall growing, long season hybrids and may not yield as much nutrients as a top grain yielding hybrid (Howell & Martz, 1993). Lauer (2009) specifies a good maize silage crop as a hybrid that has high yield, high in energy, protein and intake potential. It should also have proper moisture at harvest for storage.

### 3.6.3 Planting

The best way to increase grain content is to plant early. Through the increase of plants per ha (especially under irrigation) with between 8-10% and narrower row spacing, silage yields can be increased (Howell & Martz, 1993).

### 3.6.4 Harvesting

According to Howell & Martz (1993) the quantity and quality of maize silage are at their peak when the ear is well dented but before the leaves turn brown and dry. This is the time to harvest. Johnson and McClure (1968) found that the highest total dry matter yield per hectare (maize) to be between the dent and glaze stage of kernel development. The whole plant moisture content at this stage is about 65% (Bell, 1997). An increase of the maize plant's maturity does not have a great influence on the dry matter digestibility, but rather lowers dry matter yield and digestible protein. The ideal is therefore to harvest before this effect takes place.

**3.6.5 Chopping**

The silage must be cut into pieces. This will help with the compaction of the material and more material will fit into the silo (Howell & Martz, 1993). It will also allow better digestibility for the sheep. Important that the time period of compaction must be as short as possible (not longer than seven days). Compaction time of three minutes per ton wet silage (Meeske, 2011).

**3.6.6 Silage for Sheep**

Silage intake may vary with the stages of production of sheep. Additional dry matter in the form of grain may be necessary. Top management levels are required where silage is fed to sheep. Listeriosis (circling disease) can be a concern where silage is fed to sheep. It is a bacterium that is present in the soil. Feeding improper fermented silage to sheep is a major source of the organism. Tips for silage feeding to avoid these health problems are discussed under 3.7 Animal Health (Bell, 1997).

If fed to lambs, it is sensible to remember that the silage should be uniform, finely chopped and high in grain content. Intake will also increase if silage is fed two or three times a day, because lambs want fresh feed. As with all fermented feeds, it is important to introduce slowly and to monitor moisture levels (Bell, 1997).

Arnold (1966a, 1966b) has proven that taste, smell, feel and sight all contributed to the selection of plants by grazing sheep. When acceptability effects such as taste and odour are removed, sheep show preference for feeds they can eat faster (Kenny & Black, 1984). The intake rate of feed can also be increased by reducing particle size and making it more acceptable to sheep. Kenny and Black (1984) also state that higher intake rates allow for less discrimination between forages.

Chopping the silage particles to pieces of about 10mm will increase the intake rate of feed by sheep. They will discriminate less against certain feeds through the higher intake rate. Digestibility will also increase due to the smaller pieces and it will help to better prepare silage through better compaction of the silo (Kenny & Black, 1984).

The efficient production of precision-chopped silage requires a much larger financial investment in equipment, relative to costs associated with hay-making or grazing systems (Coblentz, undated).

## 3.7 Animal Health

Health is probably one of the greatest risks to the profitability of irrigated pastures, because the concentration of animals is very high and therefore health management needs to be very good. Smith (2007) advises producers to implement adequate health programs when practicing intensive grazing. If there is an outbreak of disease, it could very well affect the whole flock in a very short time since their concentration levels are so high.

Seib (2009) suggests a few tips to remember for maintaining a health program for a flock:

- start with the right type of sheep
- provide good feed
- cull for the sake of the flock. Wells (2010) supports it with his meaning that 80% of the problems will come from 20% of the animals. Therefore it is important to eliminate the weak ones in order to increase the flock's health levels
- be selective with replacement animals

- new animals should be quarantined until it is certain that they are healthy. This is very important when using a production system with the basic principle of buying in replacement ewes or buying in animals for a feeding enterprise
- work out a health program

Bath *et al.* (2007) recommend that management planning should consist firstly, of a basic animal management plan (describing the livestock system, i.e. lamb time, weaning period, etc.), secondly a grazing program and thirdly a health management program.

Stress can also be a factor leading to poor health. Through management it is possible to lower stress levels, for example fenceline weaning. That is where the ewes are kept in one camp and the lambs in the camp alongside them. Thedford *et al.* (undated) also suggests that the ewes should be moved and not the lamb to allow the lambs to stay in the known habitat.

Mastitis could be a problem on high quality pasture when weaning, because when weaning the lambs the ewes get a shock since they are in a high milk producing state (due to the quality fodder) and suddenly their lambs got taken away (Roeder, 2007 & Thedford *et al.*, undated). Roeder (2007a) suggests that all feed and water should be taken away for 48 hours to get them dried up.

The importance of a healthy animal and environment cannot be over emphasised. An effective disease prevention program (a vaccination- and dosage program, as well as the control of external parasites) is necessary because the saying of “prevention is better than curing” is truthful about these intensive systems.

On irrigated pastures, the following diseases should be kept in mind (Smith, 2000; Du Preez & Malan, 2006 and Malan, 2010):

- Bloat
- Foot rot
- Sore mouth
- Internal parasites
- Pulpy kidney

### 3.7.1 Bloat

Bloat is possibly the most familiar health condition when talking about pastures. The first symptom is often dead or distressed animals, thus it can be a sudden and fatal occurrence in sheep. Bloat is when ruminate animals consume highly digestible forage legumes (high in protein and low in fibre) (Smith, 2000 & Undersander 2001). It causes the pH of the rumen to drop, together with an increase of gas production and binding of protein molecules into a surface film over the ruminal contents. All these reactions cause the gas to be trapped and the animal blow up (Neary, 1997).

#### 3.7.1.1 Prevention and treatment of bloat

Planned management can reduce the risk of bloat. The following management strategies should be applied (Neary, 1997; Smith, 2000 and Undersander, 2001):

- prevent the sheep from eating too much, to quickly of these pastures
- do not turn hungry animals on fresh legume pastures
- if introduced to new pasture with a different composition of more legumes it should not be in the morning. Move the sheep in the afternoon after they already grazed for the day. It will result in them eating less new forage at first
- sheep that are new to green pastures should be gradually introduced to the pasture where they get two hours of grazing in the morning and two in the

afternoon. Continue for 2 weeks (Smith, 2004). This systematic adaptation of the sheep to the pasture is also suggested by Smith (2000)

- when there are a pasture change it will be wise to check the sheep closely for a couple of hours
- if introduced, try to stay on a constant grazing management system
- grazing should not start if the pastures is still wet from dew or rain
- use a tube in order to release free ruminal gas, if the animal can be caught;
- in life-threatening situations it will be necessary to puncture the rumen (located high on the left side of the lumbar region)
- if it is a big problem, try using sheep breeds that show more resistance to bloat
- if possible, use pasture that do not usually cause bloat
- cull animals that show bloat symptoms

Use six percent sulphur in licks to prevent bloat in sheep (Wessels, 2011). If pastures wilted, especially in times when climate changes a lot, it could be wise to utilise the irrigated pastures during the night.

#### 3.7.1.2 Foot rot

This disease is highly contagious, and can develop into a huge problem if not manage properly. Wet conditions increase the possibility of foot rot. It is thus important to be on the lookout for this disease on irrigated pastures. This is one more reason together with preventing tramping why the pasture should be allowed to dry after being irrigated. Merino and related breeds are highly amenable for foot rot (Malan, 2010).

#### 3.7.1.3 Sore mouth

Another disease to look for is sore mouth, especially because it is highly contagious if the concentration of animals is high. It forms blisters, sores and scaly in the mouth area. A veterinary should be contacted for a vaccine (Malan, 2010).

#### 3.7.1.4 Internal parasites

Internal parasites are one of the major constraints of raising sheep on irrigated pastures. It is important to remember that the major part of the internal parasite's lifecycle is outside the animal (Wells, 2010). The basic principle of rotational grazing can be used in order to fight internal parasites. It will reduce the worms but will not eliminate infections (Roeder, 2007b). The basic length of an internal parasite's lifecycle is 21 days (Maxwell, 2008), and therefore is it possible to break the cycle if the grazing system has a cycle of 24 days for example. It shows how important a grazing system is. Parasites in pastures can also be effectively managed if the pasture is grazed short enough to allow for hot summer sunlight to reach the ground (Wells, 2010). Wells (2010) argues further that rotational grazing naturally lowers parasite intake because not all larvae mature at the same time.

*Haemonchus contortus* (wire worms) is a very big problem on irrigated pastures where high losses can occur (Malan, 2010). Other parasites that can occur are *Cestoda platyhelminthes* (tapeworms) (Bezuidenhout, 1987). Malan (2010) and Van *Pletzen et al.* (2011) emphasised the importance of a dosage program, but not to over use or using it wrongly. This can lead to worms building resistance against the medication.

In an attempt to increase the effectiveness over the long term and to increase profitability of sheep farming, a system called FAMACHA was developed. It works on the principle where the mucous membrane colour of the sheep's eye gives an indication whether the sheep has internal parasites. If it is pink or white and not red, it means that the animal has internal parasites causing Anaemia. Therefore it is not necessary to dose all the sheep but only the ones containing high levels of internal parasites (Malan, 2010).

The use of the FAMACHA system will lead to lower dosage cost because the dosage frequency is lower, increasing profitability. It will result in working more often with the sheep, thus identifying problems earlier and it is possible to identify the weaker sheep and cull them to increase natural resistance of the flock against internal parasites.

#### 3.7.1.5 Pulpy kidney

One of its other names is “overeating disease”, because the conditions leading to pulpy kidney are often the result of animals overeating (Du Preez & Malan, 2006). Preventive vaccination is necessary and through managing animals new to irrigated or dryland planted pastures by implementing an adjustment period to get use to the new pasture and not to overeat. According to Brand (2007) sheep on extensive grazing should be inoculated once a year against pulpy kidney and in more intensive systems more regularly.

### 3.7.2 General Health principles

- Sheep should be fed in troughs and not on the ground to prevent the spreading of diseases and parasites.
- Ewes should be treated for internal parasites prior to breeding and at lambing time (Thedford *et al*., undated).
- Sheep must not graze *Medicago sativa* if it has been damaged by insects, hail or mechanical damage. The plants give of hormones which influence the ovulation cycle of sheep and therefore lead to ewes with lower fertility. Thus, lower lambing percentage.
- Use an ionophore in the creep feeding to prevent coccidiosis in the lambs.

### 3.7.3 Silage Health

As discussed previously, Listeriosis can be a concern with silage. Tips to use when feeding silage are:

- avoid top layer of silage from an upright silo
- avoid mouldy and spoiled silage
- avoid starting all sheep at one time from one silo, and introduce silage gradually;
- provide adequate quality and quantity of water
- avoid overcrowding and bed sheep well in wet conditions
- complete vaccination and de-worming programs well in advance of a given silage feeding period and
- follow proper sanitary/isolation procedures with replacement and sick animals (Bell, 1997)

Maize silage is low in protein and calcium, and usually requires supplementation of Vitamins D and E.

## 3.8 Carrying capacity

Limited research on carrying capacity norms for irrigated pastures is available (Van Pletzen, 2011). Irrigated pastures allows for an increase in carrying capacity (Smith, 2007). It is true that there are periods of the year that differ from each other in carry capacity due to climate changes through the year. Research done in the Cradock region showed that for seven months of the year (October - April), during the growing season, it was possible to carry approximately 50 Merino ewes per hectare (Smith, 1987). During the winter months (May - September) wheat pastures were used at an average of 37 pregnant ewes per hectare. Looking at a spring lambing season on a *Medicago sativa*/small grain pasture combination; the carrying capacity was 25 ewes (with) lambs. In Nel *et al.* (2010) a carrying capacity of 30 ewes with lambs per hectare were maintained between August and December on intensive conditions (lucerne and small grain).

## 3.9 Sheep production economics

In the introductory chapter it was said that; higher return on investments comes with higher risks and management responsibilities. The use or acceptability of a sheep production system will depend on the economic considerations like the price of meat and wool or the production inputs on the other hand (Bezuidenhout, 1987).

The setting of economic goals (Nell *et al.*, 2011) for a farmer or businessman is one of the most important initial concepts to take into account. It is vital for business's success. The function of economics is to evaluate performance which allows a SWOT-analysis. The SWOT-analysis points out strengths and weaknesses; which helps to identify the opportunities and threats to the achievement of the objectives (Nell *et al.*, 2011).

According to Van Pletzen *et al.* (2011); the guideline for the total cost of development of pastures can be R32 380 per hectare, consisting of R28000/ha for irrigation and R4380/ha for the establishment of pastures. Farming is not just farming any more. Farming is now a science and a business which illustrates how important the setting of objectives is. The norm over the last few decades was to set production goals (Nell *et al.*, 2011). That however says nothing about the economic profitability of the farm. Weaning weights, litres of milk per lactation and lambing percentage all relates to production, not profit. The objective should be given in terms of profitability where the productivity per hectare is measured (Southey, 2011). The key economic indicators are: what does it cost to produce a kilogram of the product and how much profit per hectare are generated.

Coetzee (2011) outlined the importance of the use of modern tegnology, newest sheep management and –feeding practices to increase the producer's output per hectare and productivity. Rowe (2005) as cited by Coetzee (2010) indicated that producers must feed their sheep for production at high levels, because 70% of a sheep flock's performance is determined by nutrition.

Productivity of sheep farmers is one of the most important factors, effecting profitability, that South African sheep farmers and their support structures like government need to address. Vink (2009) detailed that South Africa's productivity seems to be well below global averages and is declining, unlike the global productivity. Productivity was measured as "the proportion of the regional sheep flock slaughtered annually".

Geyer *et al.* (2011) identified the success of profitable woolled sheep farming being wool production, reproduction and effective cost control, with wool- and reproduction the most important factors influencing income. The results from study group data by Geyer *et al*. (2010) shows that wool sheep farming is profitable. Income is mainly from wool and mutton. The main Direct Allocatable Variable Costs (DAVC) for wool sheep farming is feeding (bought and self-produced) at R49.12/Small stock unit (SSU) and animal health R17.23/SSU (Geyer *et al.*, 2010). This comprises for just more than 70% of DAVC. The average overhead costs were R136.64/SSU with permanent labour and fuel expenses the highest contributors' at R40.33/SSU and R 26.56/SSU respectively. A wool/meat ratio of about 28%/72% is a good average for woolled sheep (Geyer *et al.*, 2010).

Coetzee (2012) argues that lamb- and wool production can be increased through vertical expansion and at the same time increasing effectiveness and productivity (for example higher lambing percentages, higher growth rate and fewer losses). Van Pletzen *et al.* (2011) emphasise that the expansion can only be, if the resources allows it. Higher ewe productivity is the improvement of weight of mutton as well as the amount of wool produced per hectare with woolled sheep (Wessels, 2011).

Research by Cloete *et al.* (2004) shows differences in the gross margins per SSU of different breeds, crossings and selection lines. The combination of relatively small size with acceptable reproduction and high levels of fibre production resulted in the purebred Merino-types being extremely competitive in terms of economic yield (Cloete *et al.*, 2004 and Snyman & Herselman, 2005). Breed selection is therefore important to increase profitability, but as indicated in chapter one; the biggest threat to the livestock industry is predators and stock theft.

There are a few principles to remember and use to increase profitability of sheep farming. It is well documented that there is a lot of advantages to diversification and intensification of an enterprise. Coetzee (2012) made the conclusion that the degree of intensification depends on the infrastucture, management level and budget. Intensification can be accelerated lambing systems, scanning, lambing pens and creep feeding (Coetzee, 2012). Coetzee (2010 & 2012) advices that lambs must especially be fed creep feeding to wean them at 25 kilograms.

### 3.9.1 Factors influencing sheep profitability

#### 3.9.1.1 Reproduction

The number of lambs marketed per surface area per year is widely regarded as the most important factor affecting the profitability of sheep farming (Wessels, 2011). This number of lambs is the best indicator about the ewe's productivity and can be increased through:

- getting more lambs per ewe per lambing season and to wean, i.e. increase multple births and
- the increase of the number of seasons per ewe per year, i.e. shortening of lambing intervals (Coetzee, 2010)

Reproductive rate, mature body weight, and fibre production are the primary factors determining profitability of a specific sheep enterprise (Snyman & Herselman, 2005). When a specific Merino flock has a relatively high reproductive rate, they will outperform the other breeds at all wool:meat prices ratios. The importance of fodder on reproduction is further emphasized by Smith (2004) when stated that despite the fact that lambs on green pastures is not that much heavier than lambs on natural veld, 20% more lambs were born on the green pasture. According to Londt (2011) it is possible that woolled sheep might outperform maize and wheat under irrigation. A single farm's figures shows that with a very high lambing percentage this is possible. It ads a further advantage as mentioned previously, that of risk management through diversification into meat and wool. The selection for lambs born from multiple ewes can increase the ewe flock's reproduction tempo (Coetzee, 2010).

Swart (2010) stated that farmers underestimate the importance of breeding rate, i.e. reproduction and lamb growth. It is important to select replacement ewes with multples in mind to increase reproduction rate. Van As (2012) emphasise the use of lambing pens as a method of intensification to lower lamb losses. A negative connectation with lambing pens are that farmers believe that the mother instincts can not be evaluated unless selection is used correctly.

The use of intensive sheep production systems can also lead to higher reproduction levels. It is difficult to identify the system with the highest reproduction levels, whether it is sheep in feedlots or on pastures (Bezuidenhout, 1984 & Bezuidenhout, 1987).

#### **3.9.1.2 Scanning**

Coetzee (2012) recommends that ewes be scanned 42 days after mating or insemination. All dry ewes must be marketed in order to save costs of addisional feeding for the supposed to be pregnant ewes. If the producer decide to keep the dry ewes, they can be marked and if they skip with the mating period she must be sold (Calldo *et al.*, undated). Especially with intensive sheep production systems, it will be wise to sell them, because if there is no production from the ewe it is unwise to keep her. Woolled sheep further decreases the producer's risk, because if the ewe did not lamb, there is at least wool to sell to settle part of the costs.

#### 3.9.1.3 Ewe care

The understanding of the physiological effects of an ewe is very important, because the management of these effects has an effect on reproduction (Schutte, 2008), widely regarded as the most important factor affecting the profitability of sheep farming (Wessels, 2011). A folikel take about six months to grow and develop, making the nutrition six months before mating very important (Calldo *et al.*, undated & Schutte, 2008). The embryo also develope almost 72% during the last six weeks of pregnanc. High quality nutrition during this six weeks is very important, because this is also the time when the wool folikel in woolled sheep develop, effecting the sheep's wool production for the rest of its production cycle (Schutte, 2008).

#### 3.9.1.4 Ram care

Ram care is very important due to the mating with more than one ewe. Defects in the ram, can lower conception and in the end reproduction (Schutte, 2008). Rams should be tested for fertility before mating starts (Snyman & Herselman, 2005) and start with a fitness program for the rams about two months before mating (Schutte, 2008). Start nursing the rams about two months before mating, because sperms takes about two months to develop and mature. Shear the rams two months before mating if necessary (Calldo *et al.*, undated & Schutte, 2008).

#### 3.9.1.5 Lambing system

The producers choice of lambing system will depent according to Wessel (2011) on the factors such as the area of farming, sheep breed, fecundity and the availability of water, pasture/vegetation, supplementation and available and quality of labour. The three main production systems used when farming with sheep is lambing in autumn, lambing in spring or accelerated lambing systems (Schutte, 2008).

Intensification is not a solution for poor nutrion and management practices, because accelerated lambing systems is precisely about high nutritional and management levels (Coetzee, 2010 in Wessels, 2011). Schutte (2008) and Wessels (2011) highlighted the fact that these accelerated lambing systems requires higher management inputs than the one lambing per year system.

These accelerated lambing seasons are not recommended in extensive areas where fodder flow problems are more often encountered (Wessels, 2011). According to Coetzee (2010) these systems are more suitable for irrigated pastures. The number of lambs weaned over a period can be increased, but nutritional requirements, production costs, labour and the facilities must also be higher for accelerated lambing systems (Schutte, 2008). The advantages of an accelerated lambing system is:

- higher lamb production
- supply of lamb is more evenly distributed through the year
- better utilisation of labour and facilities and
- higher income per ewe per year (Schutte, 2008)

#### 3.9.1.6 Supplementation

A study by Bezuidenhout (1984) found that it is neccesary to provide energy supplements to ewes in the 6-weeks before lambing and during lactation. It should increase sheep production and mass increases after weaning. Dry hay, even if it is not the best quality, should be supplied to animals on irrigated pastures. It will also help in preventing bloat and pulpy kidney (Bezuidenhout, 1987).

The carrying capacity of grass:clover pastures can be very high, but there are certain periodes when it will be lower. The reason being a decrease in growth rate if it is to warm or to cold. The shortages can be bridged with the plant of alternative crops. An alternative is to use high quality *Medicago sativa ad lib*. with a P6-lick (Coetzee, 2010).

#### 3.9.1.6.1 Creep feeding

Creep feeding is the managerial practice of supplying supplemental feed (usually concentrates) to the nursing lamb, while excluding their mothers (Schoenian, 2010). The goal with creep feeding is to suppurt the lamb from 10-14 days after birth to reach weaning weight as soon as possible (Coetzee, 2009). Important to make sure that there is enough feeding space for the lambs. The advantages of creep feeding:

- lambs grow better
- lambs can be marketed earlier
- a large percentage of the lambs can be marketed direct from the ewes
- stres at weaning is less
- save feed costs because the lamb is marketed earlier and the ewe can be switched to a cheaper ration (Coetzee, 2009) and
- higher feed conversion efficiency (Schutte, 2008)

According to Coetzee & Malan (2008) the Merino is the sheep breed with the lowest number of bloat problems. Snyman & Herselman (2005) showed that Merino lambs takes the longest interval to reach slaughter weight when compared to Afrinos and Dorpers. The use of creep feeding could be an important input to support the Merino lamb to reach its slaughter weight as soon as possible.

## 3.10 Basic Business Principles

According to Pienaar (2010) and Nell *et al.* (2011) there are six very important business disciplines or pillars to be a succesful livestock farmer. These disciplines or pillars includes the following:

- **Marketing**, this is the force that propels the business into the future. Important thus, to effectively use the assets to produce a quality product to market.

- **Finance**, this is the subsitance generated by a succesful business model and therefore the farming business needs cash flow. The main issue being interest on investments.
- **Product**, very important to ensure that the product's quality is good and continuously available. Production must be productive.
- **Factory**, the farm is an open factory. It must use it is recources like fodder and water to produce products efficiently. Therefore manage the pastures.
- **People**, be surrounded with competent people, outside, but also on the inside of the business or farm. Training, evaluation and remuneration support them these people to become more competent.
- **Adaptability**, the farm must measure and be able to adapt due to new information. The succesfull manager will  see changes in trends and make the appropreate adjustments to create a competitave advantage.

# CHAPTER 4
# Results and Discussion

## 4.1 Introduction

Four sheep production systems in Central South Africa were constructed as “typical” farms according to the *Agri Benchmark* methodology and analysed with the TIPI-CAL simulation model. The research question is: What system is the most profitable, giving the investor (farmer) the highest return on capital invested?

## 4.2 Economic situation on whole farm level

The economic situation of the whole farm and the other comparisons with their discussions to follow were done to compare the four sheep production systems as a whole. Each of the four systems only has a ewe enterprise producing return on capital. The systems producing crops and forages produce it to supply the sheep with fodder because the main activity of all four systems is sheep production. The return structure is the total turnover per ewe enterprise of all four the sheep production systems.

Figure 4.1 clearly shows that the returns/income from the two intensive sheep production systems are much higher than the extensive systems at R4 027 000 and R4 335 000 for the silage and irrigated pastures respectively. The reason for the higher whole farm income is mainly because they use between 600 to a 1000 ewes more than the semi-extensive- and extensive systems (Figure 4.2). A further reason for the higher income is because of the income per ewe that is the highest for the irrigated pasture- and silage systems: The income per ewe was:

- Extensive system R1332 per ewe
- Semi-extensive system R1245 per ewe

- Silage system R1611 per ewe

- Irrigated pasture system R1806 per ewe

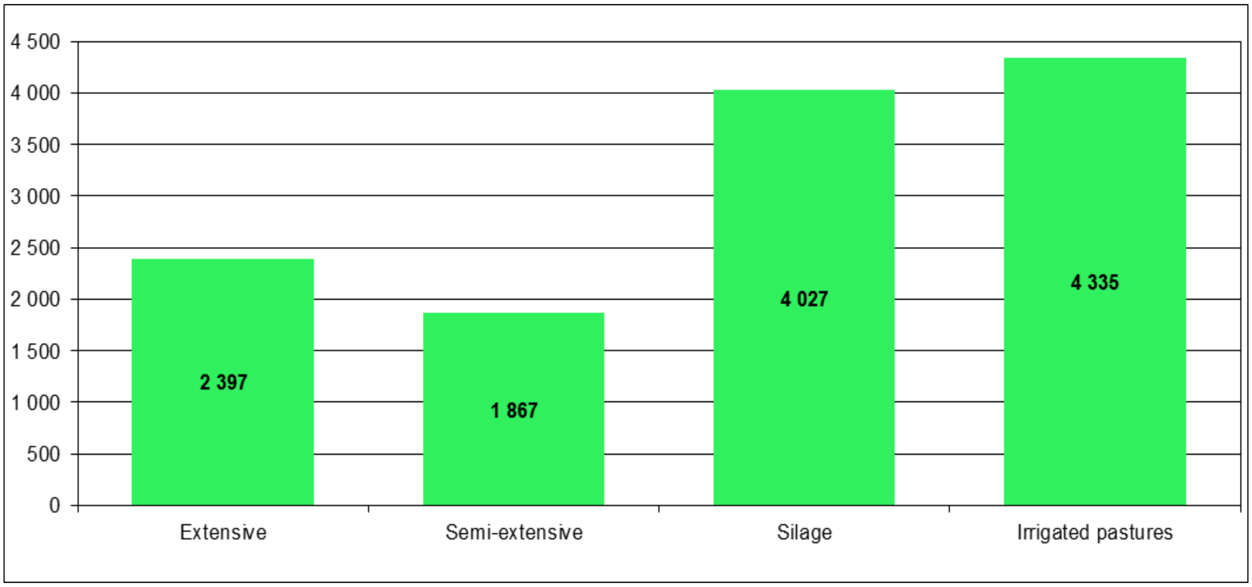


**Figure 4.1: Return Structure – Rand per year for the different production systems (R1000 / farm / year)**

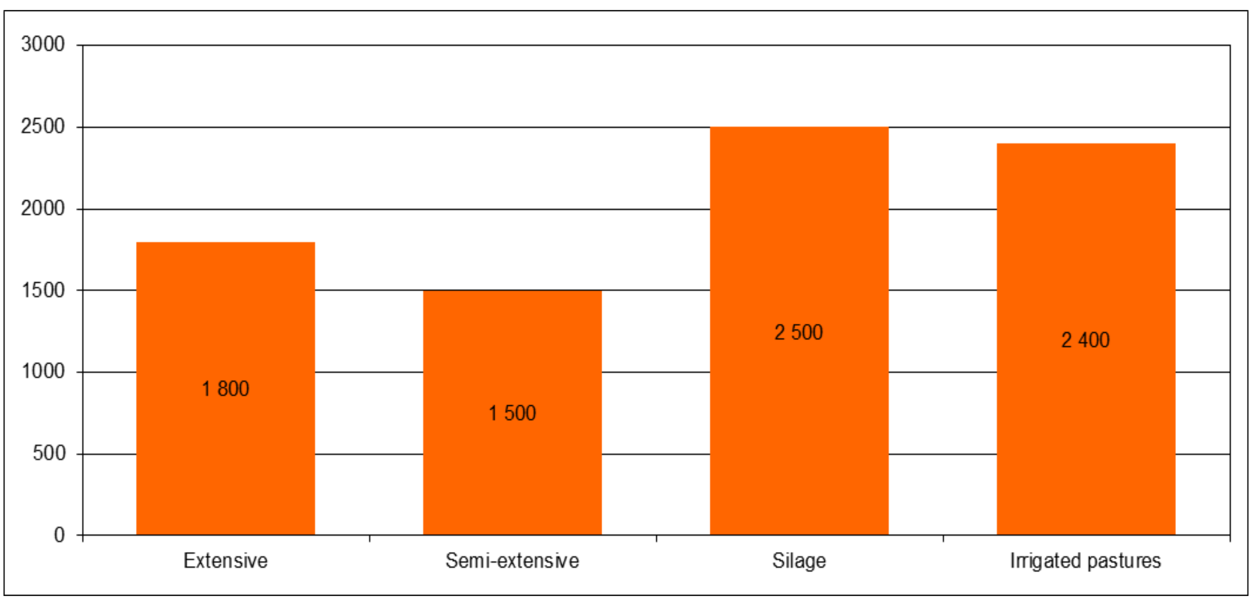


**Figure 4.2: Ewe numbers per system**

The extensive- and semi-extensive sheep production systems whose main source of fodder is natural veld, carries 1800 and 1500 ewes respectively (Figure 4.2). It is clear when looking at Figures 4.2 and 4.3 that the irrigated pasture system is an intensive system carrying 2400 ewes on 80 ha at 30 ewes per hectare.

The silage system uses 40 hectares to produce *Medicago sativa* (lucerne) maize- and pea silage to feed to the sheep, while the 7000 hectares is only used for about three months of the year when the ewes are not in production. The 2500 ewes from Figure 4.2 on the 40 hectares used to produce the silage give a stocking rate of almost 62.5 ewes per ha for nine months. The variations in land use is large and if less emphasis is placed on the 7000 ha of the silage system. The intensive systems clearly have the highest stocking rates, even for the silage system if the 7000 ha is ignored.

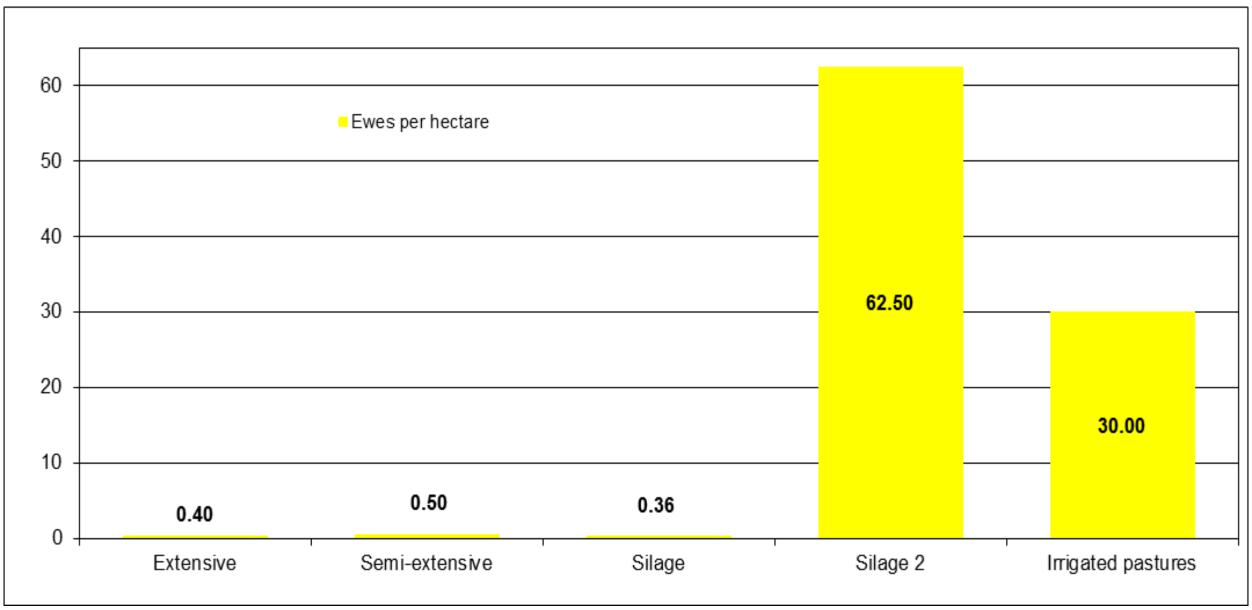


**Figure 4.3: Stocking rate (ewes/ha)**

The profit margin of the whole farm in Figure 4.4 is the share of the farm income in the total income. The systems compare very well with each other in terms of the profit margin percentages, except the silage sheep production system the lowest at 32 percent. The silage system is more than half the margin when compared to the other systems. The two extensive sheep production systems (79% and 68%) show the highest profit margin but their ewe total turnover in Figure 4.1 is lower than the intensive systems.

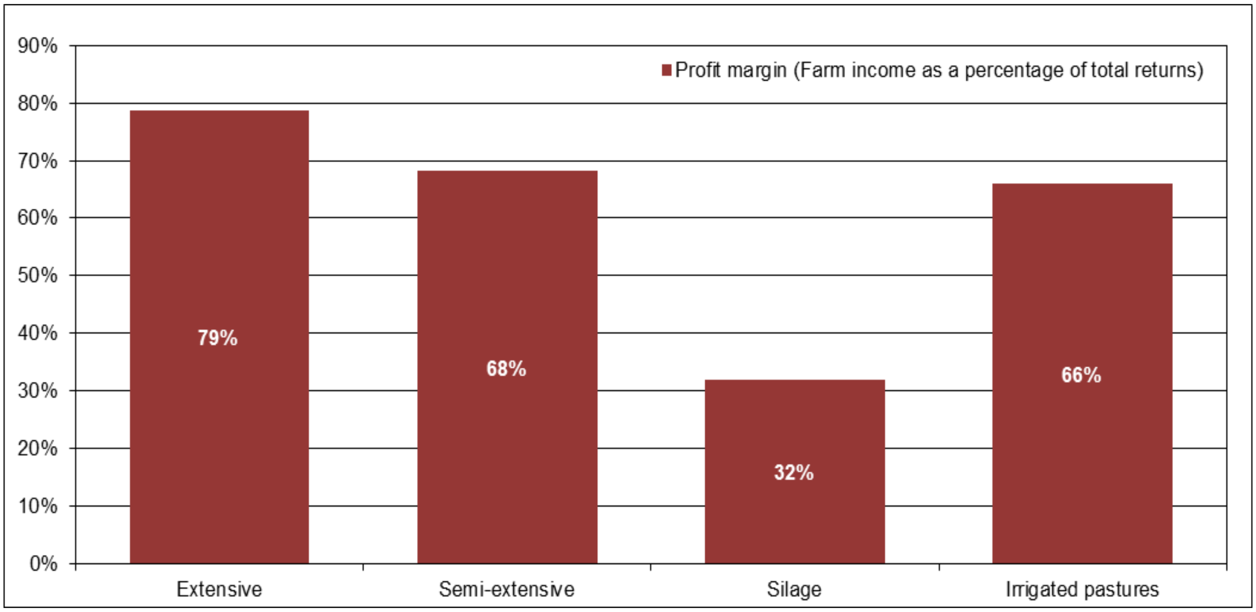


**Figure 4.4: Profit margin (%) of the whole farm (ewe enterprise)**

The total live weight sold per ewe (kg LW per ewe) (Figure 4.5) is comprised by animals culled, breeding animal (if relevant) sold and lambs sold. The irrigated pasture system was the top performer producing 55kg live weight per ewe followed by the silage system. The extensive- and semi-extensive systems produce 39kg and 37kg respectively per ewe per year. The 55kg per ewe from the irrigated pasture system is made up of the total kilograms of animals that were culled divided by the total ewes in the system plus the total kilograms of lambs live weight sold divided by the total ewes.

**Table 3: Live weight sold per hectare**

| | Extensive | Semi-extensive | Silage | Silage 2 | Irrigated pastures |
|---|---|---|---|---|---|
| **Ewes per hectare** | 0.40 | 0.50 | 0.36 | 62.50 | 30.00 |
| **Cull animals** | 5.60 | 7.00 | 4.97 | 875.00 | 420.00 |
| **Slaughter lambs** | 10.00 | 11.50 | 13.49 | 2375.00 | 1230.00 |
| **Total LW sold per hectare** | 15.60 | 18.50 | 18.47 | 3250.00 | 1650.00 |

Table 3 gives the total live weight sold per hectare, while Figure 4.5 shows the total live weight sold per ewe. Silage 2 where the live weight sold was calculated only on the silage hectares shows the highest total live weight sold per hectare. The profit margins in Figure 4.4 illustrates that despite the larger live weight sold per hectare by the silage system, it is needed to look deeper into the system. The silage system has the second highest income (turnover).

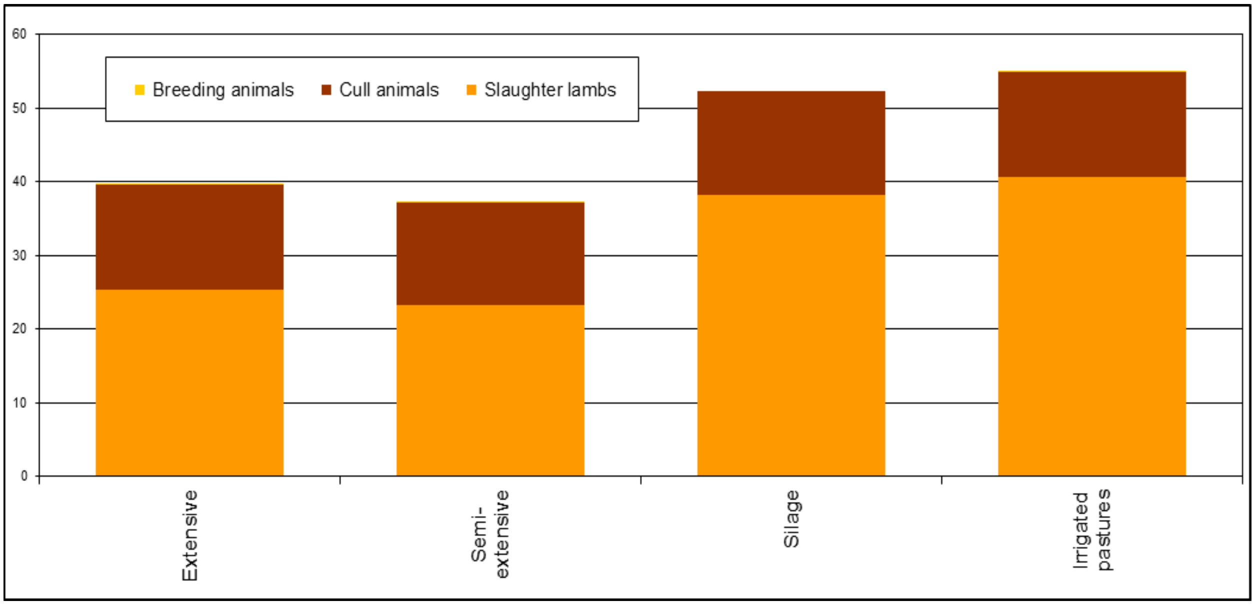


**Figure 4.5: Total live weight sold per ewe (kg LW per ewe)**

## 4.3 Ewe Productivity

The lambs weaned per 100 ewes per year were all in the excess of 110% and higher with only the semi-extensive system's weaning percentage 99% (Figure 4.6). Lambs weaned per ewe according to Warn *et al*. (2006) are a profit driver but its influence on profitability had a smaller impact than increasing the stocking rate or carrying capacity. The irrigated pasture system has the highest weaning percentage or highest number of lambs (184) weaned per 100 ewes per year. The weaning figures from the silage- and irrigated pasture sheep production system were adjusted to an annual basis because three lambing seasons per ewe every two years were used.

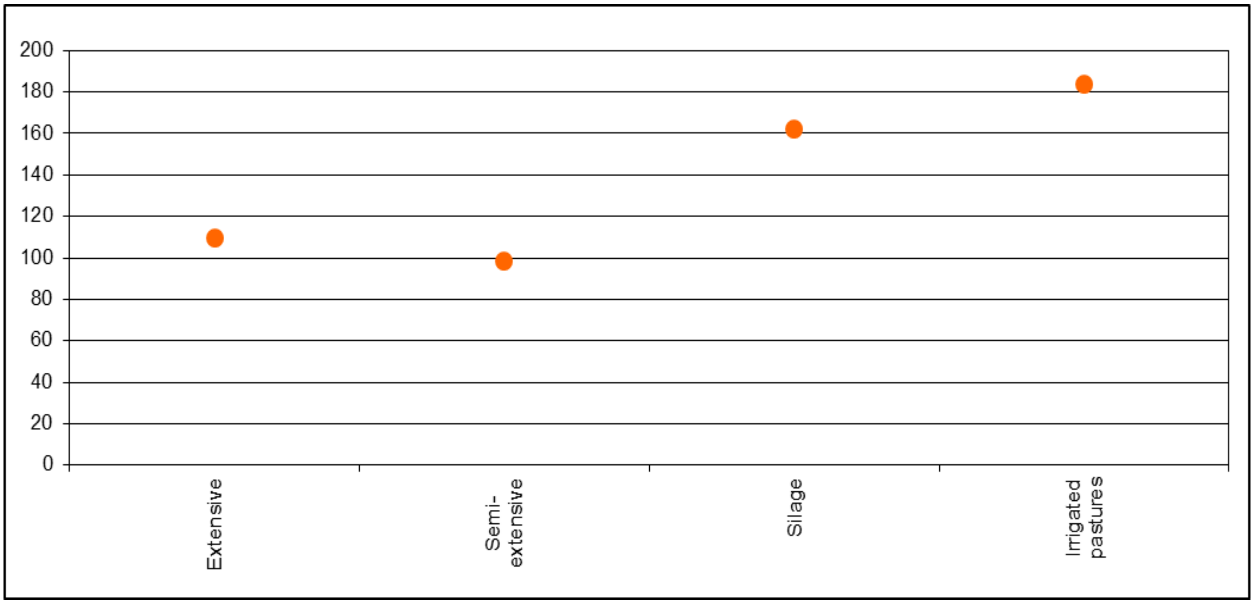


**Figure 4.6: Weaned lambs per 100 ewes and year (lambs / 100 ewes and year)**

The weaning ages between all four systems differ, especially between the extensive and semi-extensive systems. The weaning ages from the more extensive systems vary between 110 to 135 days and the intensive systems between 75 to 80 days. It is clear that the intensive sheep production system's weaning periods are much shorter than the others (Figure 4.8). The main reason for these shorter weaning periods is because their average daily weight gain (DWG) according to Figure 4.9 is higher by almost 100 grams per day. The simulation model assumed that the lambs were slaughtered at weaning. The weaning weights of the systems were at 26-34 kilograms a bit lower than normal slaughter weights. However, according to Warn *et al*. (2006) profitability will not improve when the sale weight increase because it will reduce the number of ewes that can be carried which might cause a decline in wool and mutton production.

The younger weaning ages from the silage and irrigated pasture sheep production systems is possible because the average daily weight gain (DWG), that's the lamb's growth rate, were approximately 100 grams per day higher between the lowest and highest (silage) system. The silage system was the best with a DWG of 310 g/day from birth to slaughter, followed by the irrigated pasture- and extensive system at 286.67 and 231.81 g/day respectively. The semi-extensive system with 211.11 g/day had been the lowest (Figure 4.9). High feed energy content, as in the silage system; contribute largely to achieving high weight gains. It is supported by findings in Deblitz (2010a) where beef finishing in silage systems (with longer finishing periods) come close to feedlot performances in terms of daily weight gain. The weaning cost per lamb will in the end be an important indicator of comparison. The cost of each system weaning at 30kg is given in Figure 4.7. The silage system again weaning a lamb at a cost of R500.50 and the extensive system at R169.10 per lamb weaned.

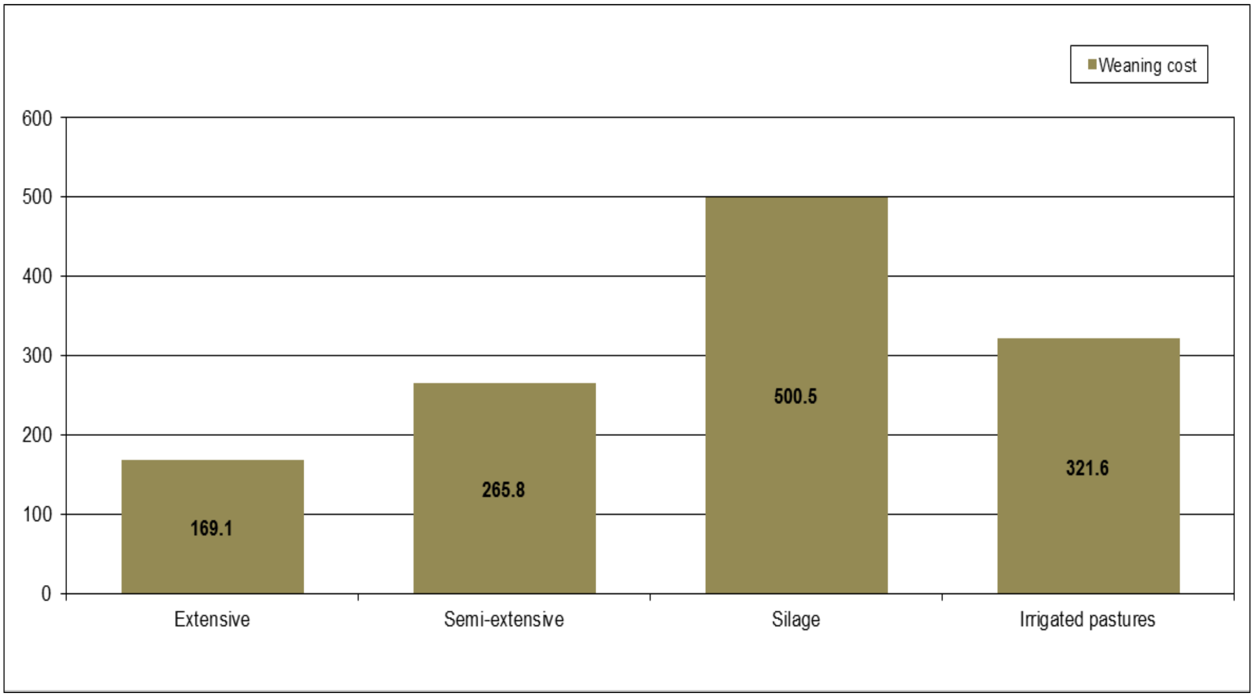


**Figure 4.7: Weaning cost per lamb (Rand/weaned lamb)**

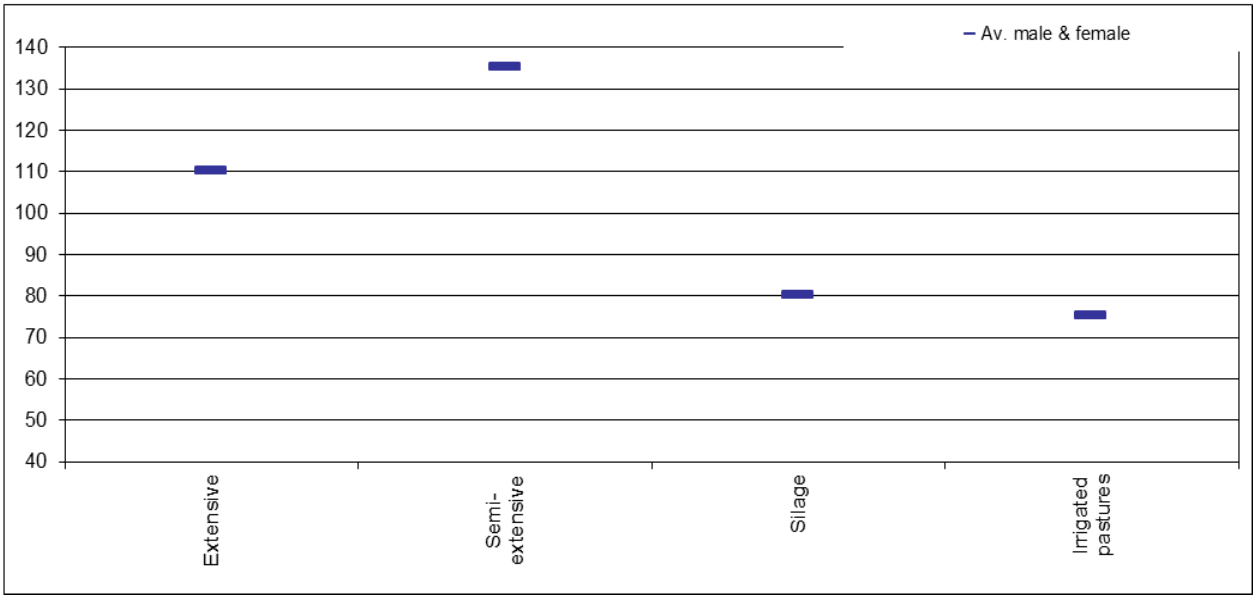


**Figure 4.8: Weaning age (= weaning period) (days)**

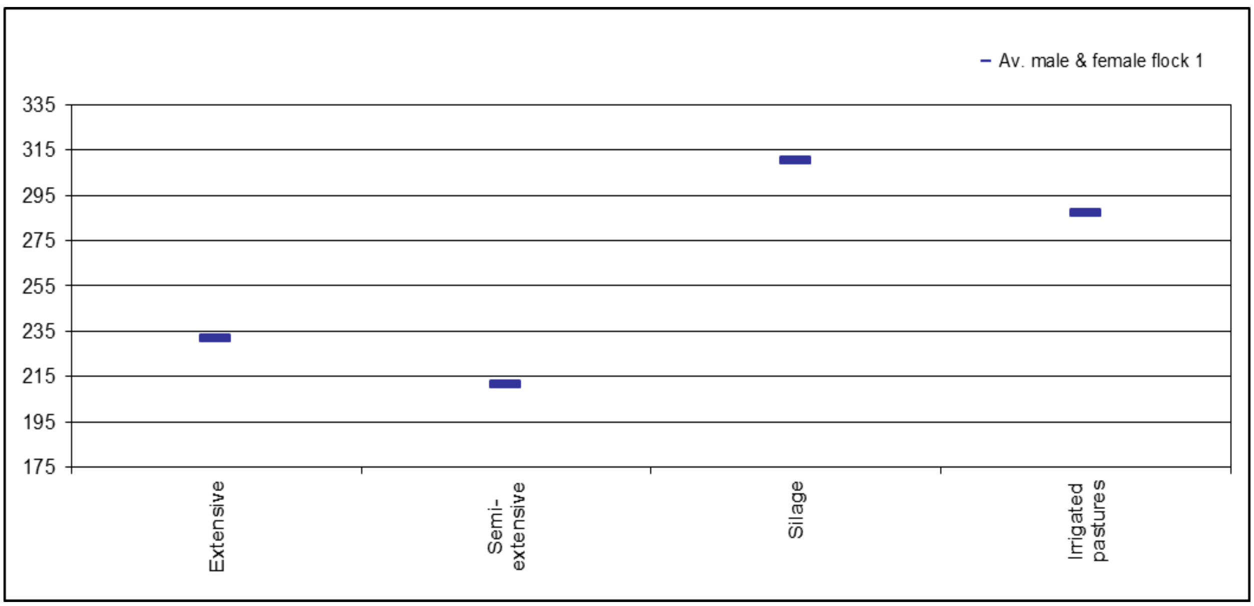


**Figure 4.9: Growth rates – birth to slaughter (g/day)**

The ewe productivity is clearly higher in the intensive systems when looked at Figures 4.6 - 4.9. The higher growth rates in the intensive systems allow earlier weaning. A higher DWG is maintained due to the constant availability of quality fodder. Weaning can therefore be earlier and the ewe can be prepared for mating much quicker, allowing three lamb seasons in two years. The weaning percentages were also a lot higher on the intensive systems.

## 4.4 Incomes of the ewe enterprises

Figure 4.10 shows the total income of the ewe enterprise in Rand per 100 kilograms of live weight sold (Rand/kg LW). The total income in Figures 4.10 and 4.11 are thus expressed per 100 kg LW sold and the percentage composition of the total income per system respectively. The silage and irrigated pastures have the highest income from slaughter animals per 100kg live weight weaned/sold, whereas the extensive and semi-extensive systems showed the highest income from culled animals (Figure 4.10). Culled animals are the old ewes that are replaced by the 20% replacement ewes. The slaughtered animals are basically the lambs weaned minus the replacement ewes.

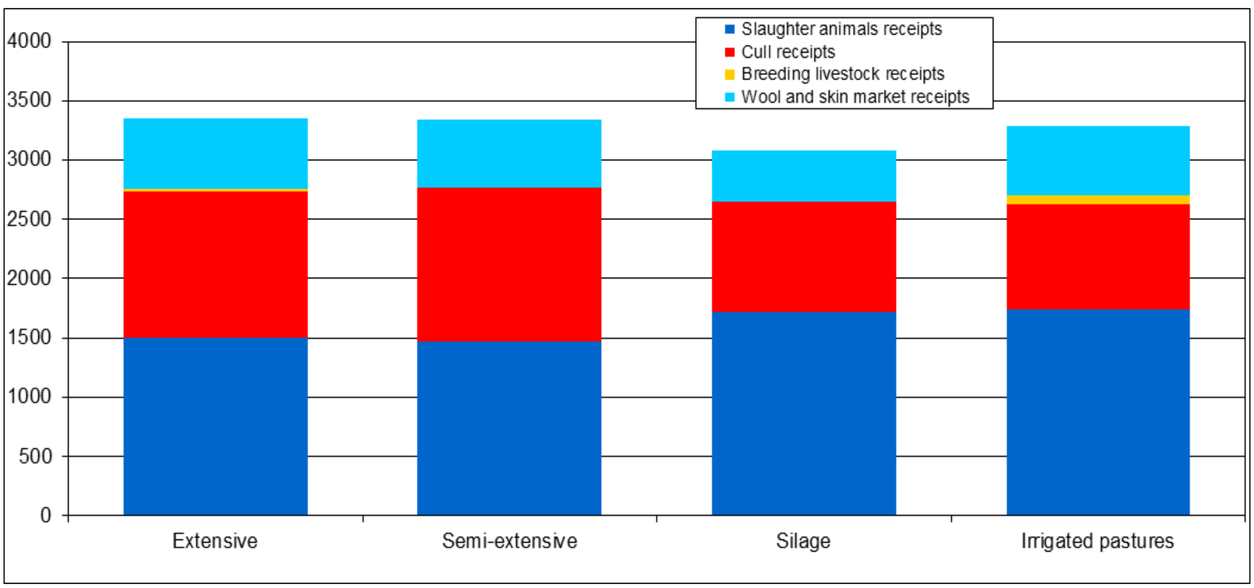


**Figure 4.10: Total income of the ewe enterprises (R/100kg LW)**

Income from livestock sold for breeding are only 1% from the extensive system and 2% from the irrigated pastures which could be a transaction that occur only by opportunity such as replacement ewes that were in surplus. The wool income of the ewes per 100kg live weight was almost equal at 17% and 18%. It is only the intensive system using silage for sheep production where wool makes up only 14% of the total income from its ewe enterprise (Figure 4.11). Annual wool production per ewe on irrigated pastures according to Bezuidenhout (1987) can be about 70% higher than on naturel veld with several studies by Hall *et al*., (2007) and Moore G, Sanford P & Wiley (2006) showing the positive impact of improved pastures in the wool income due to quality wool production. This study shows a discrepancy from the literature, with the income from wool in Figure 4.10 differentiating with only 4 percent. The wool production from the ewes in the silage system producing 6.2kg, 7kg in the extensive and semi-extensive systems and 7.4kg from the irrigated pastures. The wool income per 100kg live weight sold was the highest on the irrigated pastures.

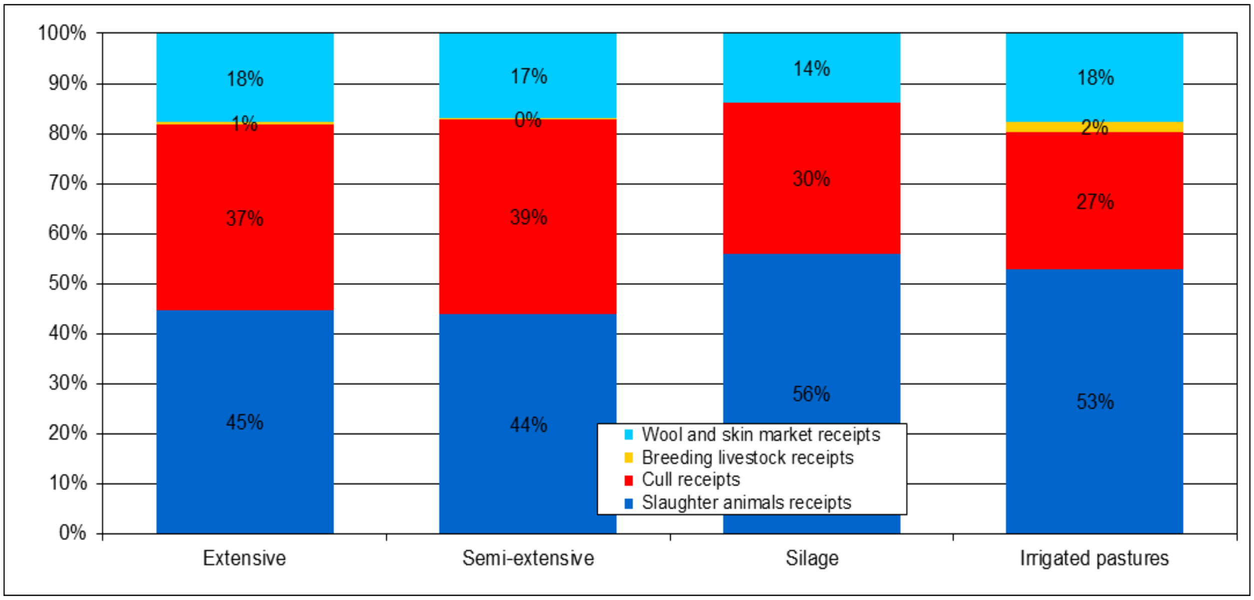


**Figure 4.11: Total income of the ewe enterprises (%)**

## 4.5 Costs of the ewe enterprises

Figure 4.12 gives the factor (mainly labour-, land- and capital costs, it includes opportunity costs) and non-factor costs (costs like feed costs, seed, fertiliser) or variable costs of the ewe enterprises in percentage composition. Factor costs are mainly labour-, land- and capital costs. Capital cost contributes the least to the costs of the ewe enterprises. The non-factor cost is the greatest contributor to the total cost of the ewe enterprises, except in the extensive systems where total land cost moved the non-factor cost's contribution to the second highest contributor of the total ewe enterprise's costs. It can be because of the larger surfaces of the extensive systems. The majority of the non-factor costs are related to feed purchase and feed production (seeds, fertiliser, pesticides, machinery, fuel and energy).

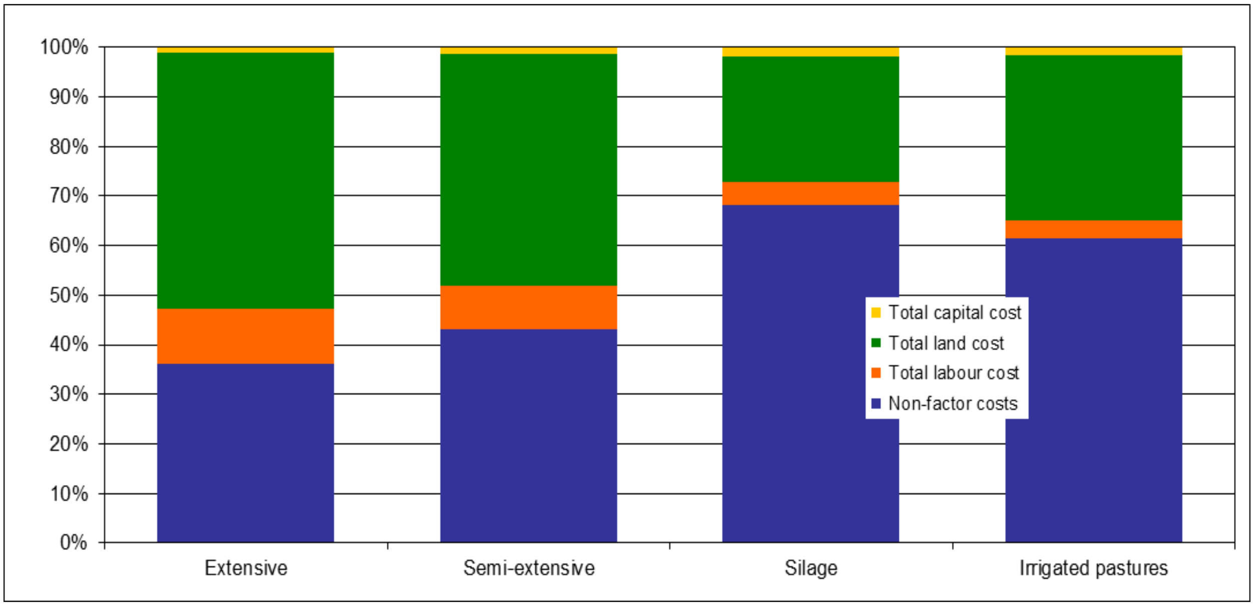


**Figure 4.12: Cost composition of the ewe enterprise by factor and non-factor costs**

Figure 4.13 gives the non-factor costs per 100kg live weight sold. The non-factor costs associated with the silage system is by far the highest of all the systems. The biggest contributor to this system's non-factor costs was feed which is made up mainly from purchased feed, fertiliser, seed and pesticides. Feed is also a big cost when looking at the irrigated pasture and semi-extensive systems. The establishment of pastures for these two systems being the main inputs in terms of feed costs.

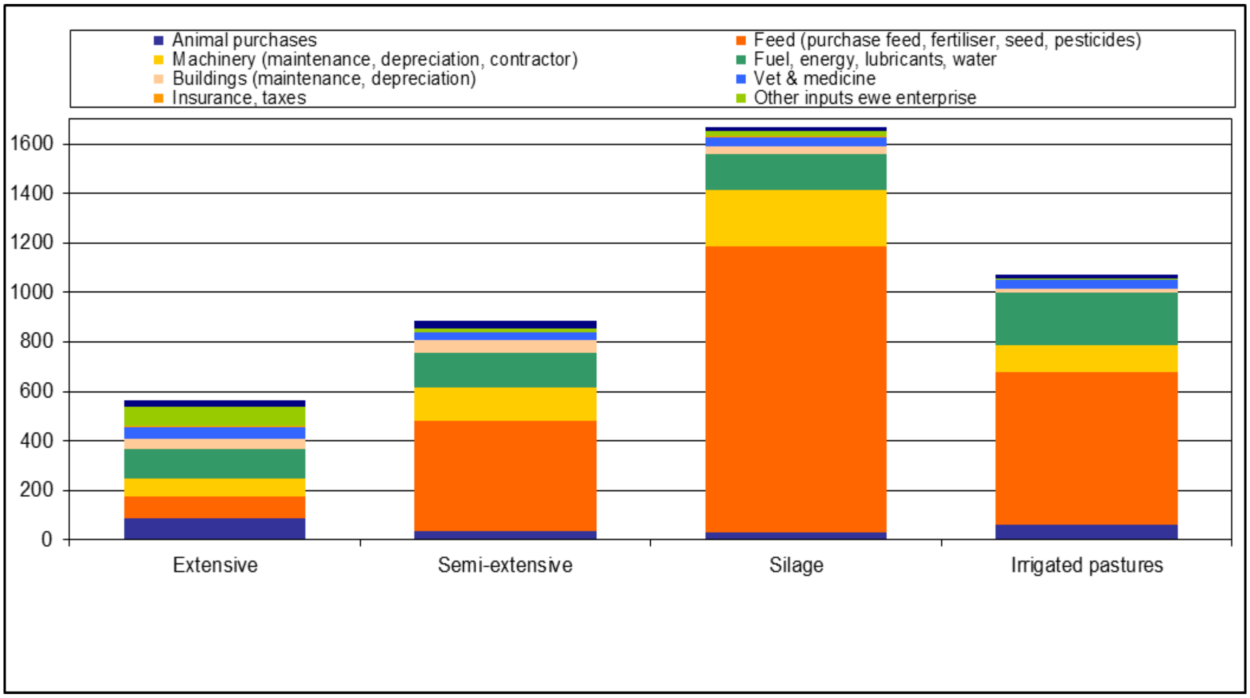


**Figure 4.13: Non-factor costs (R/100 kg LW)**

The biggest contributors to the non-factor costs of the ewe enterprise according to Figures 4.13 and 4.14 is feed, machinery and fuel, energy, lubricants and irrigation water. Feed is responsible for 69% of the silage sheep production system's non-factor costs. Machinery costs are reasonable consistent for all the systems between 10-15% of the non-factor costs. The feed costs of the extensive system are the lowest of all systems on 15 per cent (Figure 4.14).

Feed costs do not only contribute highly to non-factor costs, but also 62% and 54% of the total costs for the silage and irrigated pasture systems respectively. Feed costs are highlighted in Davies & Deblitz (2010) as costs for:

- Purchase feed;
- Production of own pasture, forage and grains (seed, fertiliser, pesticides);
- Machinery including contractors;
- Fuel, energy, lubricants, water; and
- Land rents plus opportunity cost of own land.

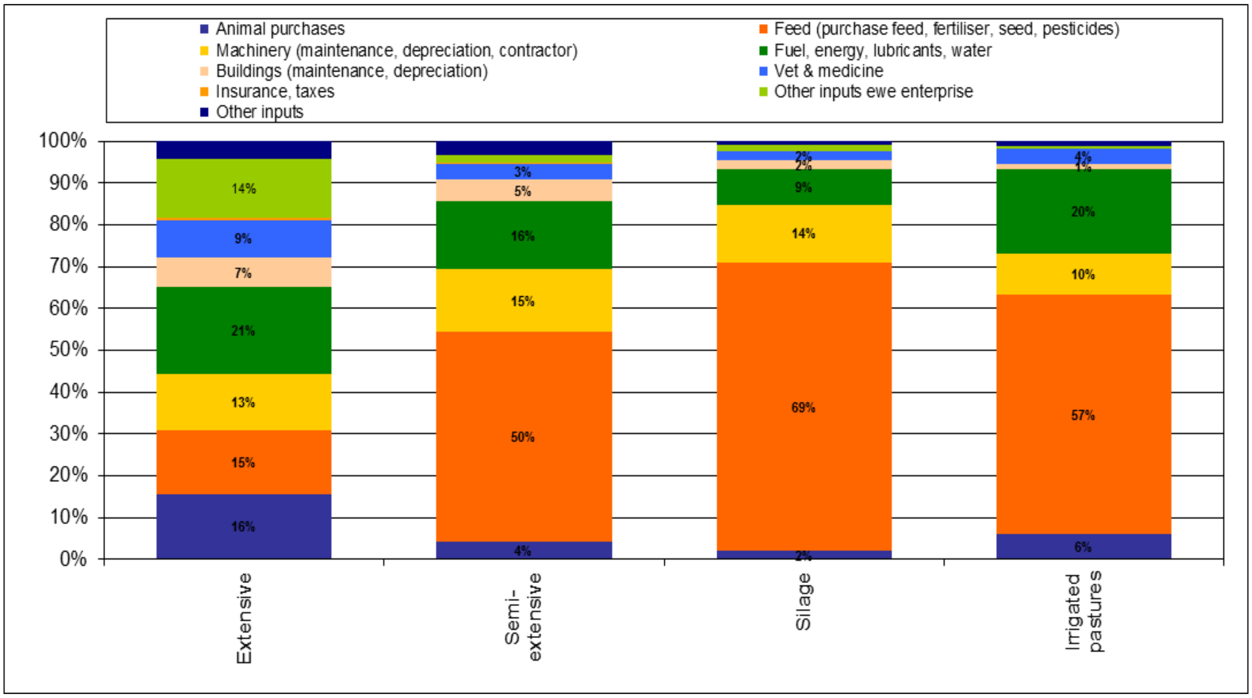


**Figure 4.14: Non-factor costs – percentage composition (%)**

Geyer *et al*. (2010) also found from their study group results that the main direct allocatable variable costs (DAVC), which is the non-factor costs, were feeding followed by animal health. According to Jasper (2011) feeding expenses it is important to know that the feed costs are a high contributor to costs and to manage it accordingly. Keep control over it by producing your own protein as far as possible. Make sure that the feeding practices are effective through optimum nutrition during the different physiological stages of the breeding ewe. It is essential for high reproduction rates and lamb growth. The high feed costs place some pressure the profit margins (%) of the systems, as can be seen in Figure 4.4 with the high cost composition of the silage system in Figure 4.14 with feeding costs contributing almost 69% of non-factor costs.

## 4.6 Wool indicators

The wool income as a percentage of the total income of the ewe enterprises were almost equal for the extensive, semi-extensive and irrigated pastures, but wool income from the silage system was a little bit lower at 14% (Figure 4.15). The wool income per ewe from the silage system at R224 per ewe per year is higher than the R211 per ewe from the semi-extensive system. The higher percentage income from slaughter animals that the silage sheep production system has (Figure 4.11) however, lowers its wool's contribution. The irrigated pasture sheep production system has the highest income per ewe of R318 per year (Figure 4.16). This could be due to more wool income from better quality wool produced from quality pastures (Hall *et al*., 2007) as well as higher volumes of wool from better fodder (Bezuidenhout, 1987). The extensive and semi-extensive systems compete well against the other systems in terms of wool income per ewe. The incomes from wool will automatically be higher from the intensive systems carrying more sheep per hectare.

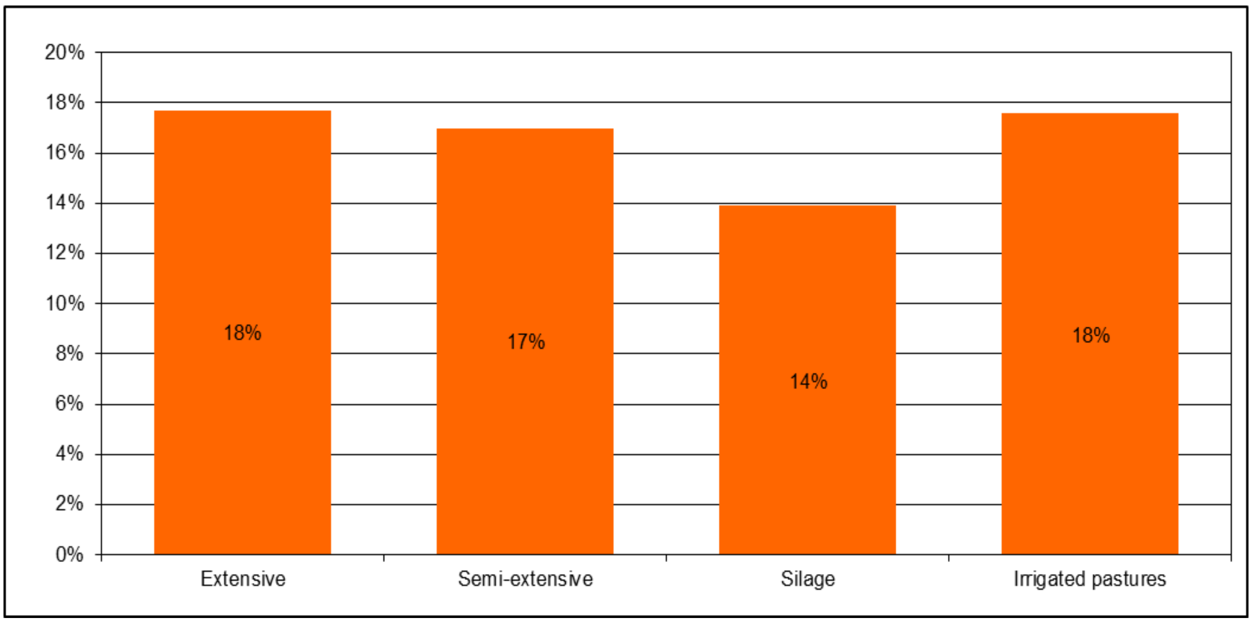


**Figure 4.15: Wool income as a percentage of total income (%)**

Geyer *et al*. (2010) showed the importance of wool to the total income from a sheep. It is responsible for between 28-30% of the total income. It is further important to diversify in wool and mutton to spread the risk. It will bring stability to the enterprises return to capital, thus profitability.

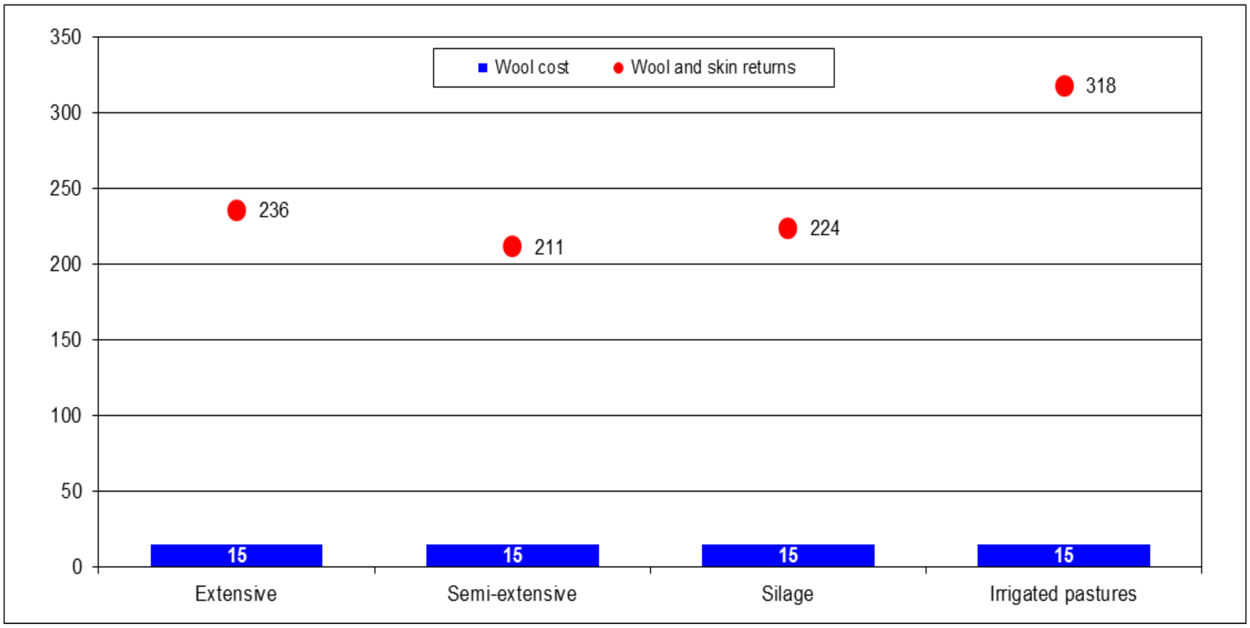


**Figure 4.16: Wool income and costs (Rand/ewe)**

## 4.7 Labour and management: Prices, Productivity and Costs

Labour cost is determined basically by two factors: productivity (kg mutton per hour labour input) and wages. Figure 4.20 where the relation between physical and economic labour productivity is given shows the highest productivity ratio for the silage system.

Labour cost varies between R9 - R10 per hour. The productivity of labour will always be a question that remains debatable. The physical labour productivity (kilogram live weight sold per hour of labour input) with South African farms being the lowest, were highlighted in Davies & Deblitz (2010). Australian farms in Davies & Deblitz (2010) produced between 35-75 kg LW per hour of labour input, whereas South African farms produced 3-5 kilograms. The reasons for the high figures for Australia were their larger flocks that gave them economies of scale while they minimise labour (due to high wages) and rather make use of contracted labour. The irrigated pasture system shows the highest labour productivity with 13 kg LW/h produced (Figure 4.17). The main advantage of this system is economies of scale and it uses 1-2 labourers less than the two extensive systems and 3 labourers less than the silage intensive system. It is perhaps the most important difference when comparing the silage and irrigated pasture systems. This higher level of labour for the silage system was highlighted by Hutton (2008) as one of the disadvantages of silage production systems.

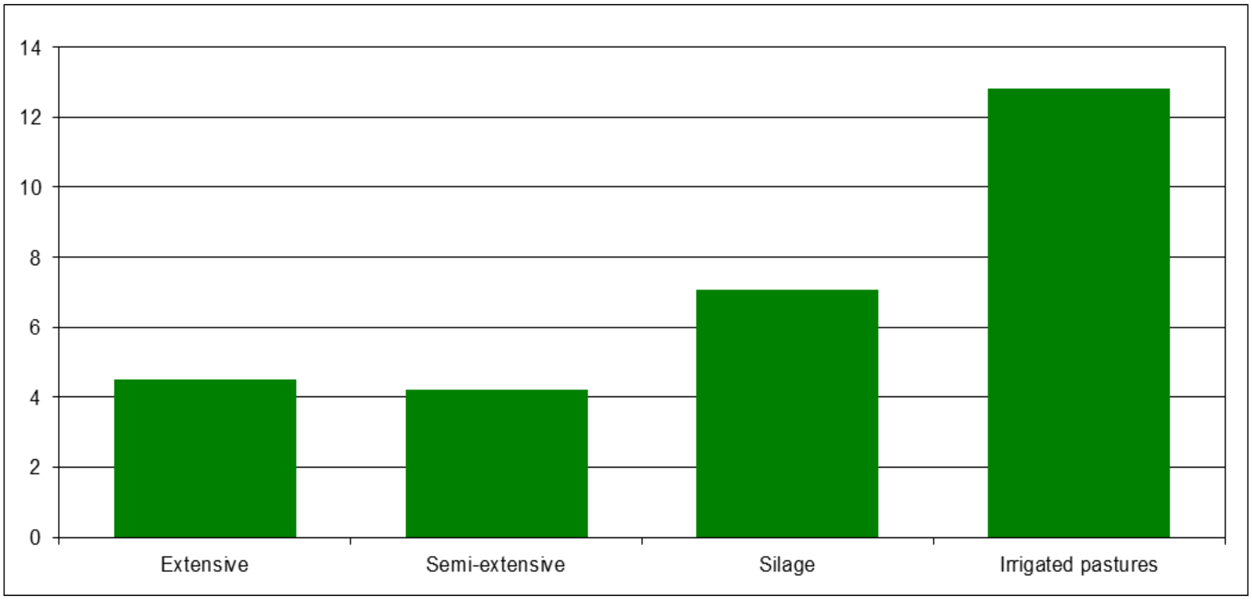


**Figure 4.17: Labour productivity (kg LW/h)**

The cost of labour in Figure 4.18 is the lowest in the irrigated pasture sheep production system at R59 per 100kg live weight sold. The low cost of labour is a function of the lower number of labourers used in the system and the higher total live weight sold for the system as a whole (Figure 4.5). The opposite is true for the extensive and semi-extensive systems with lower ewe numbers and therefore less live weight sold per system. Their labour costs (R171 and R176 respectively) are accordingly divided through a smaller amount of live weight that was sold giving a lower labour cost per 100kg live weight sold. In terms of economic labour productivity the irrigated pasture sheep production systems did the best at R56 per unit labour cost (Figure 4.19).

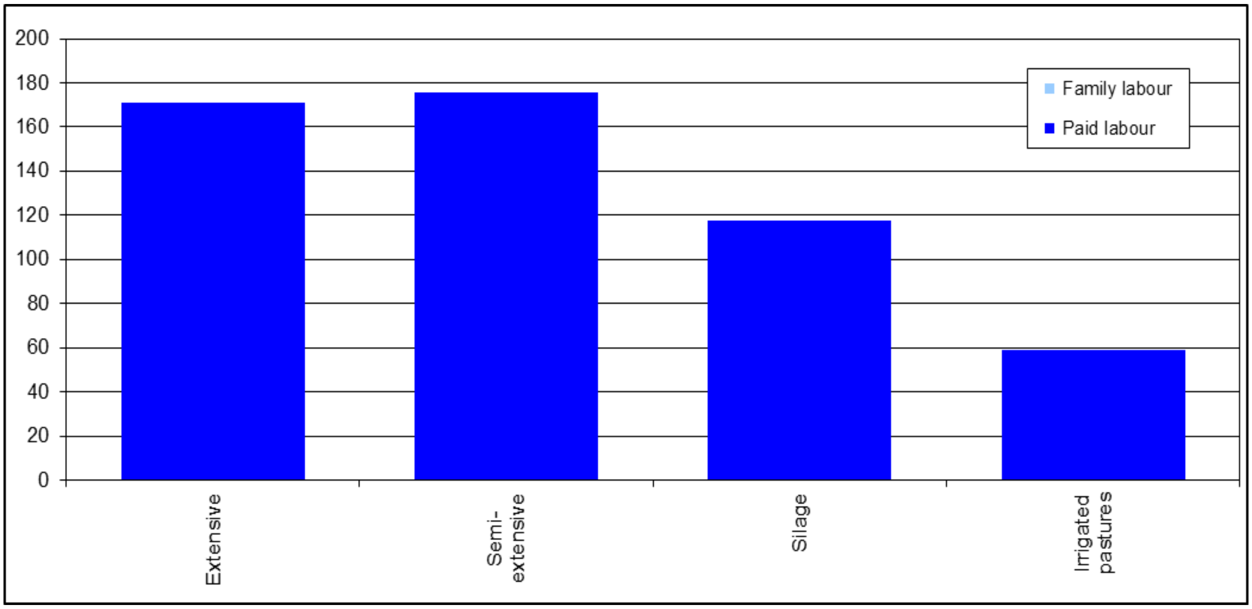


**Figure 4.18: Labour cost (R/100 kg LW)**

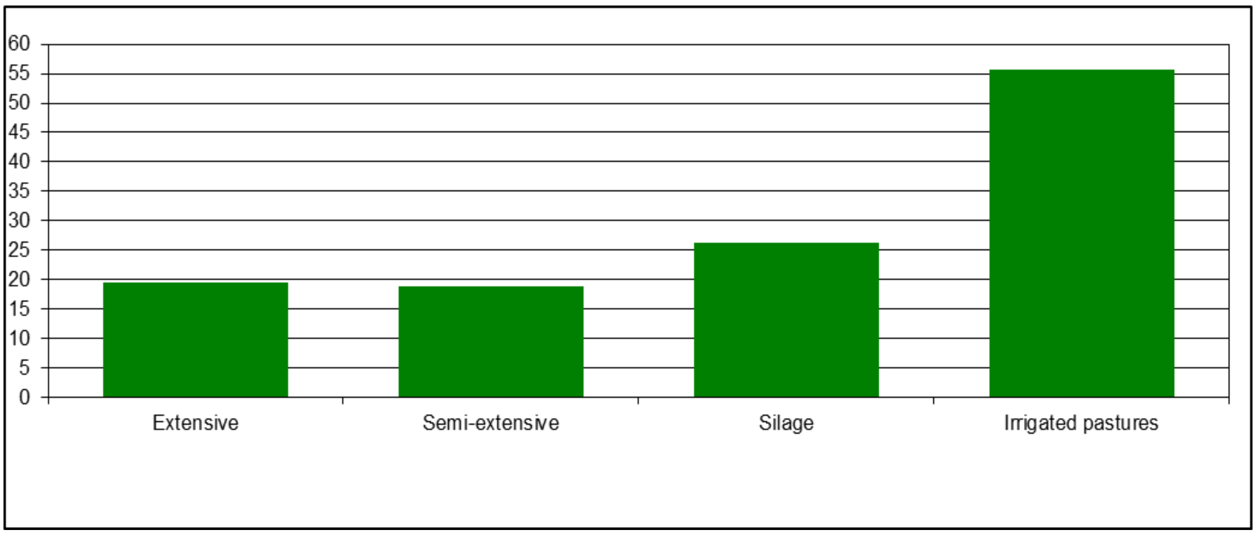


**Figure 4.19: Economic labour productivity (R income / R total labour cost)**

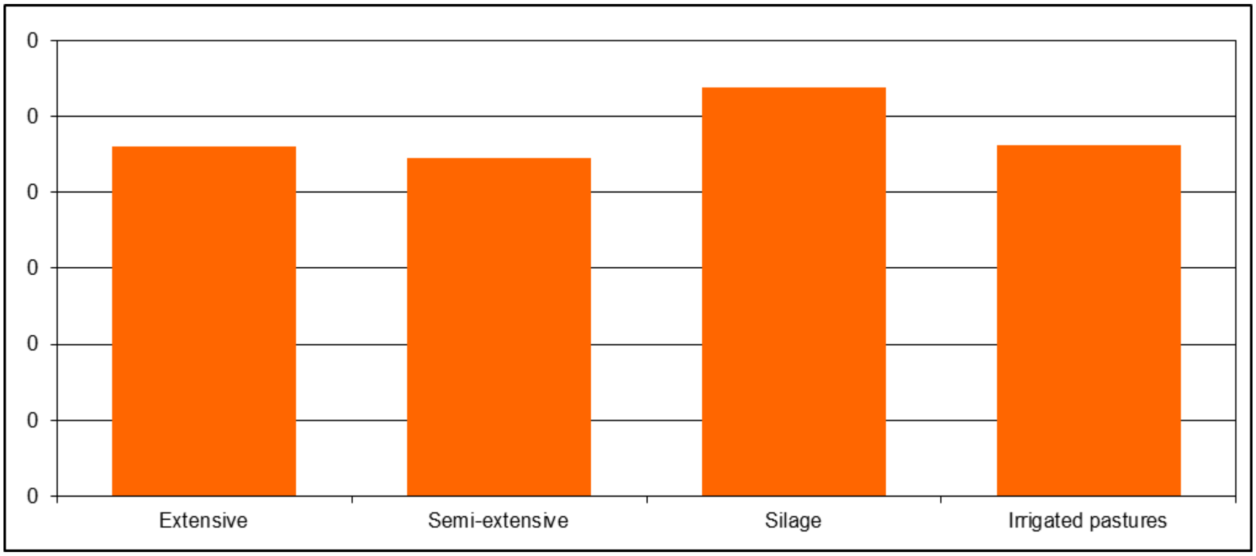


**Figure 4.20: Physical vs. economic labour productivity ratio (factor x.x times)**

Considering the previous figures comparing the more extensive systems with the intensive systems, the expectation was that the land productivity for both the intensive systems should be higher than the extensive systems. However, Figure 4.21 shows a low productivity for the silage system, which is contrary to the expectations. The silage system produces 131 tons of live weight compared to the irrigated pastures with 132 tons on 80 hectares. The lower land productivity for the silage system is because the model uses the total hectares of a system and includes the 7 000 ha natural veld that is utilised only for three months in a year. If the 7 000ha are excluded like in Figure 4.21 with 'Silage 2', then the land productivity is much higher for this intensive sheep production system producing then 3 344 kg live weight per hectare. The silage system should be handled as a full system, which actually excludes it from comparisons where production per hectare is involved.

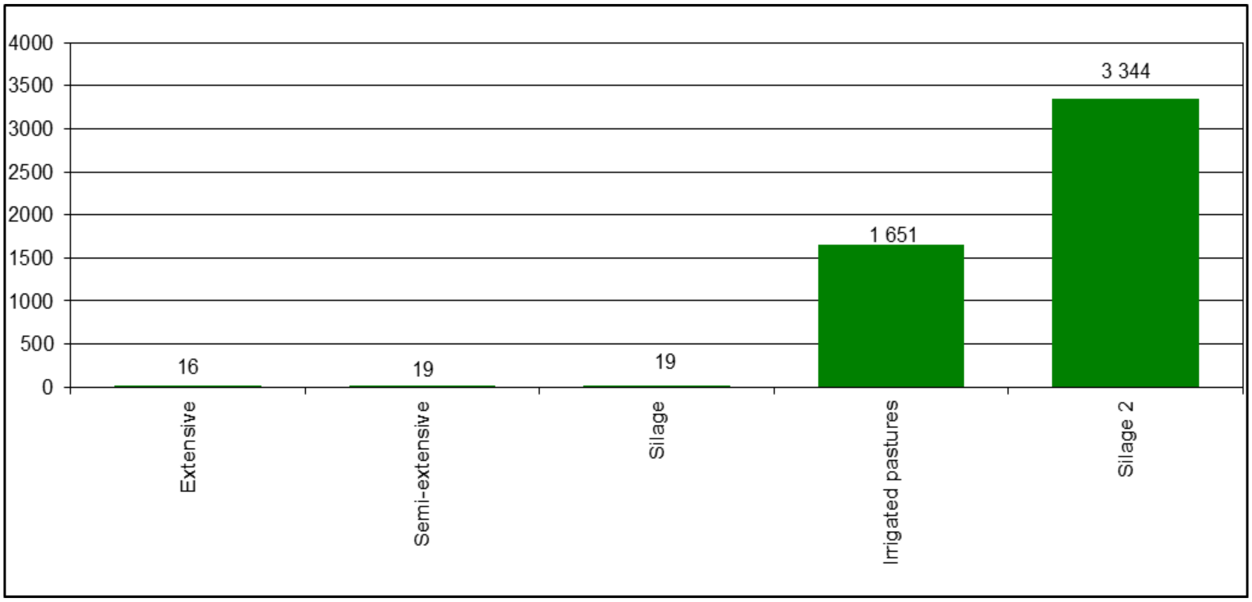


**Figure 4.21: Land productivity (kg LW/ha)**

The land costs which include rents paid and opportunity costs for own land is given in Figure 4.22 in Rand per 100kg live weight sold. The extensive and semi-extensive system shows the highest land cost. The land cost for the four sheep production systems is mainly opportunity costs with only the 7000 ha from the silage system that is rented.

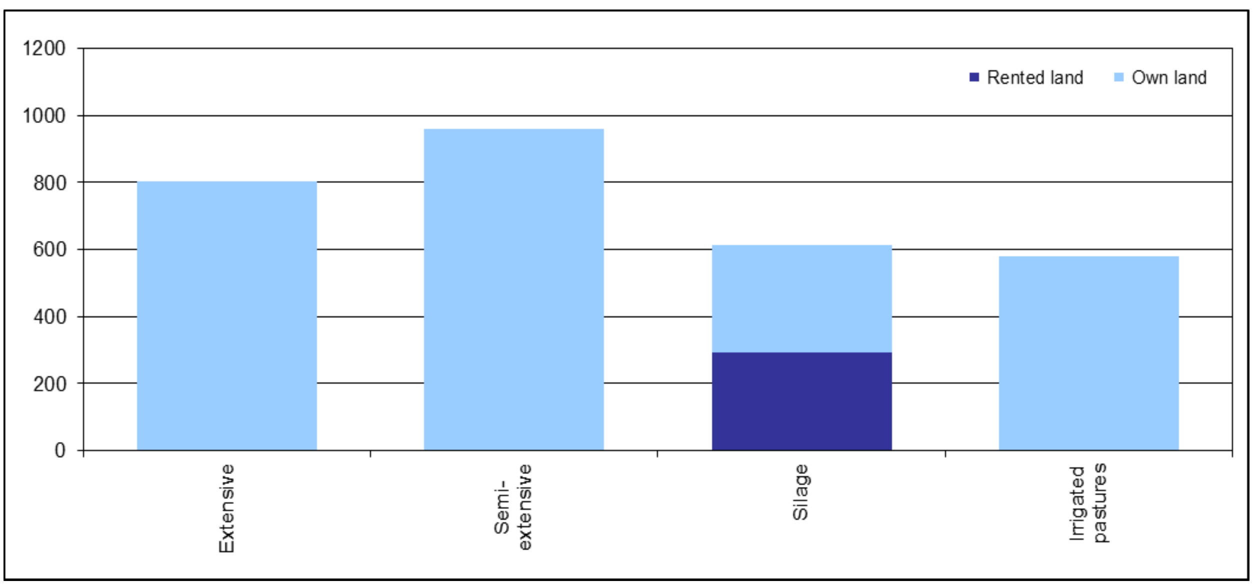


**Figure 4.22: Land cost (R/100 kg LW)**

## 4.8 Capital prices, Productivity and Costs

The interest rates for own capital were taken at 3% with the rate for the simulated credits (when there happens to be cash deficits) taken as 9% and 10% the average interest for total liabilities for the credit (CR) systems. The extensive sheep production system has the highest capital productivity of 1 710 kg live weight sold per R1 000 capital invested. The silage system has the lowest productivity of 651 kg of live weight sold per R1 000 invested (Figure 4.23). Figure 4.23 shows further that when 50% of the capital invested on machinery, buildings and facilities are leased (CR) then the two extensive systems have the steepest decline in capital productivity compared to the intensive systems.

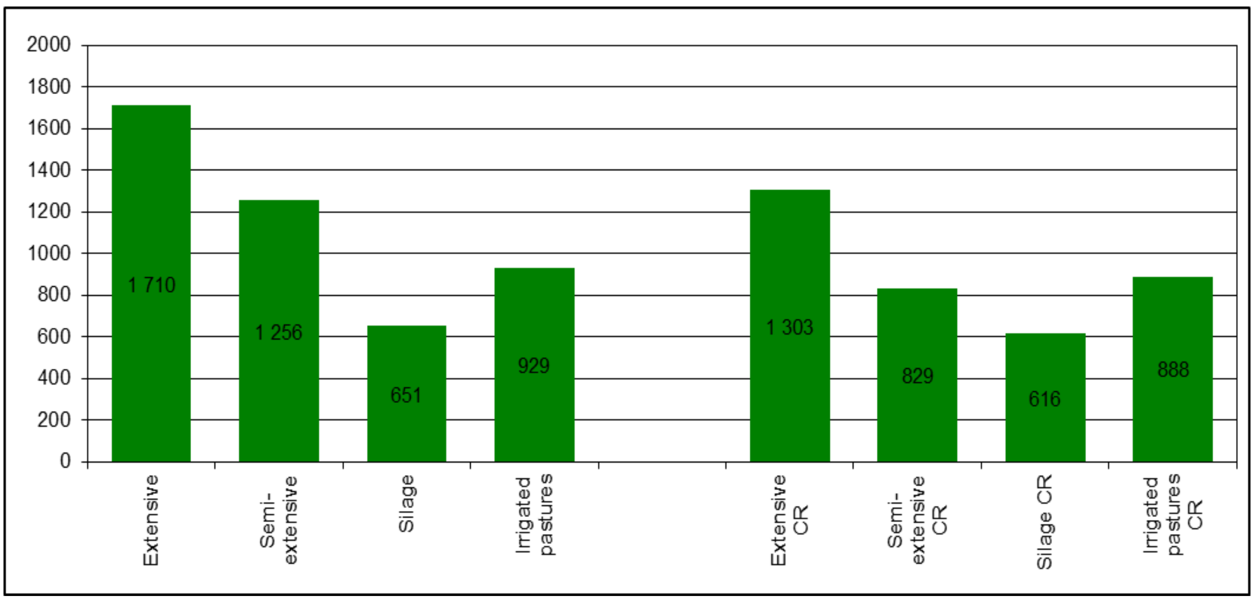


**Figure 4.23: Capital productivity (kg LW/R1000)**

Capital costs are the interest paid and the calculated interest for equity (non-land assets). According to Figure 4.24 all four sheep production systems used approximately 50% own capital. If the assumption is made that 50% of the system's capital (land excluded) were leased, then it is clear that own capital is almost out of the equation. The cost of the capital increased for the extensive-, semi-extensive, silage- and irrigated pasture system with 194%, 214%, 130% and 148% respectively when 50% of the capital is on credit.

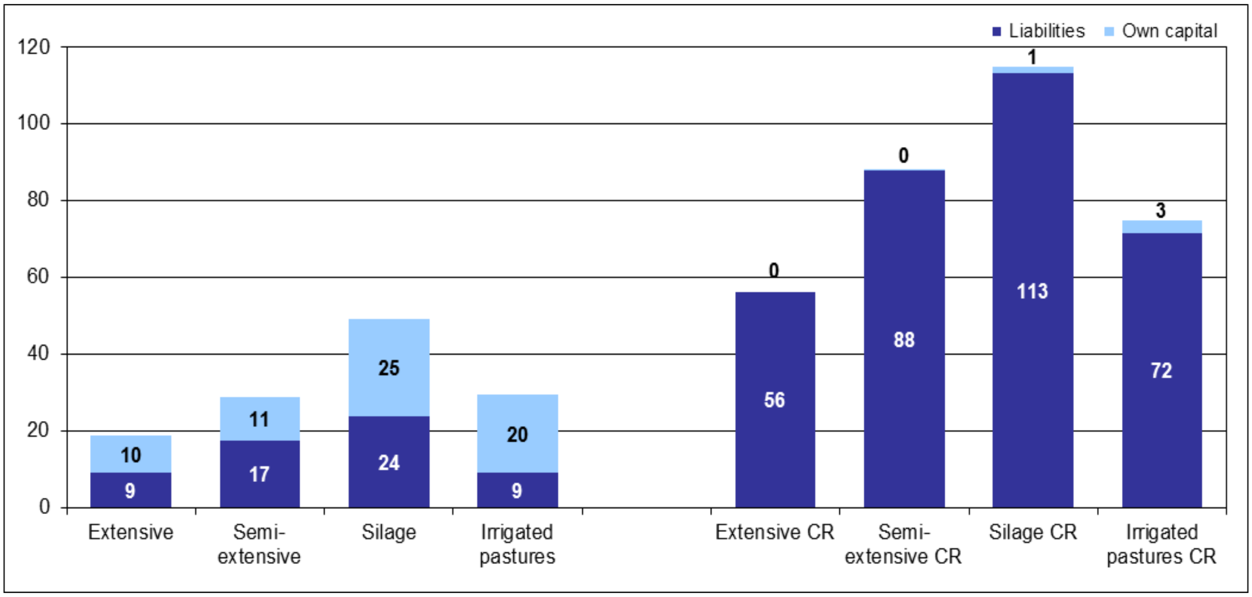


**Figure 4.24: Capital cost (R/100 kg LW)**

## 4.9 Profitability figures and concluding remarks

The main objective of this study was to evaluate the profitability of the four sheep production systems that uses extensive natural veld, semi-extensive system, silage and irrigated pastures for sheep production. Following the objectives stated in Chapter 1, this profitability figures is the most important part of the results described in this chapter so far. The previous results were focussed more on comparisons between the systems and its effects on profitability and returns on capital (ROC).

The silage and irrigated pasture systems have the highest market returns/income (Figure 4.1), but to evaluate the efficiency and profitability of a system, the costs and must also be included in the conclusions. The profit margin (Figure 4.25) for these two intensive systems is the lowest compared to the extensive systems. The semi-extensive and irrigated pastures differ only 2% in profit margin with the extensive system having the highest profit margin of 79%. Even when 50% of the capital was invested on credit, the profit relation between the systems stayed the same (Figure 4.25). It is clear from Figure 4.26 that all four systems can cover their total cost of production. The profit margin is the lowest for the silage system due to mainly the high feed costs that is part of the cash costs in Figure 4.26. All four farms are profitable in the long term (Figure 4.26).

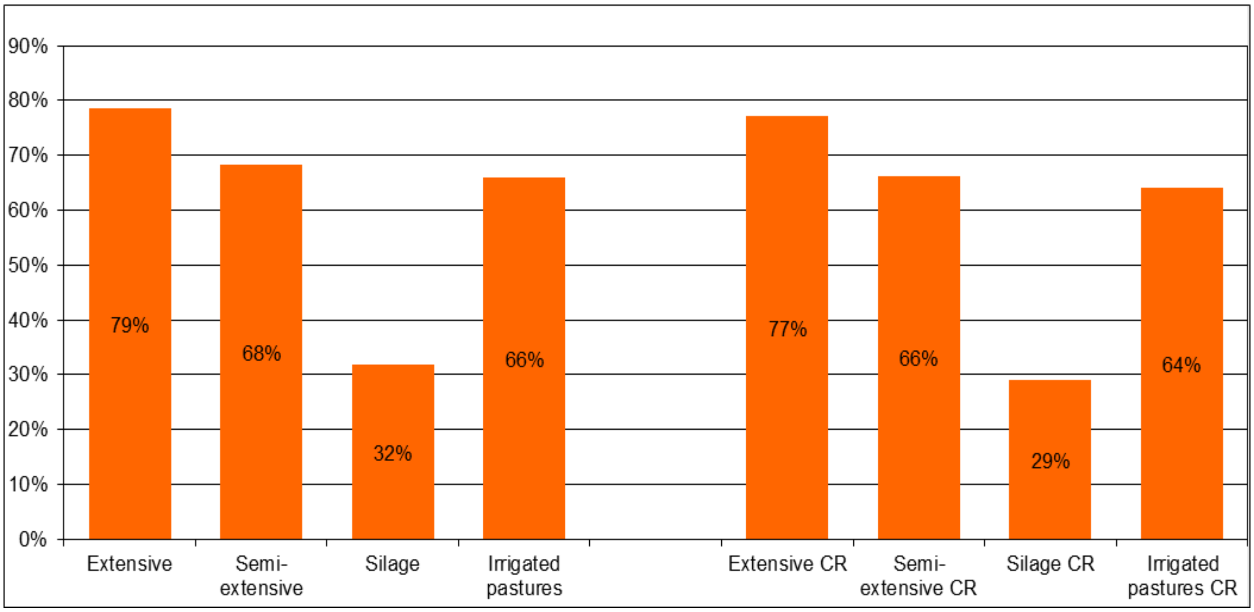


**Figure 4.25: Profit margin (%)**

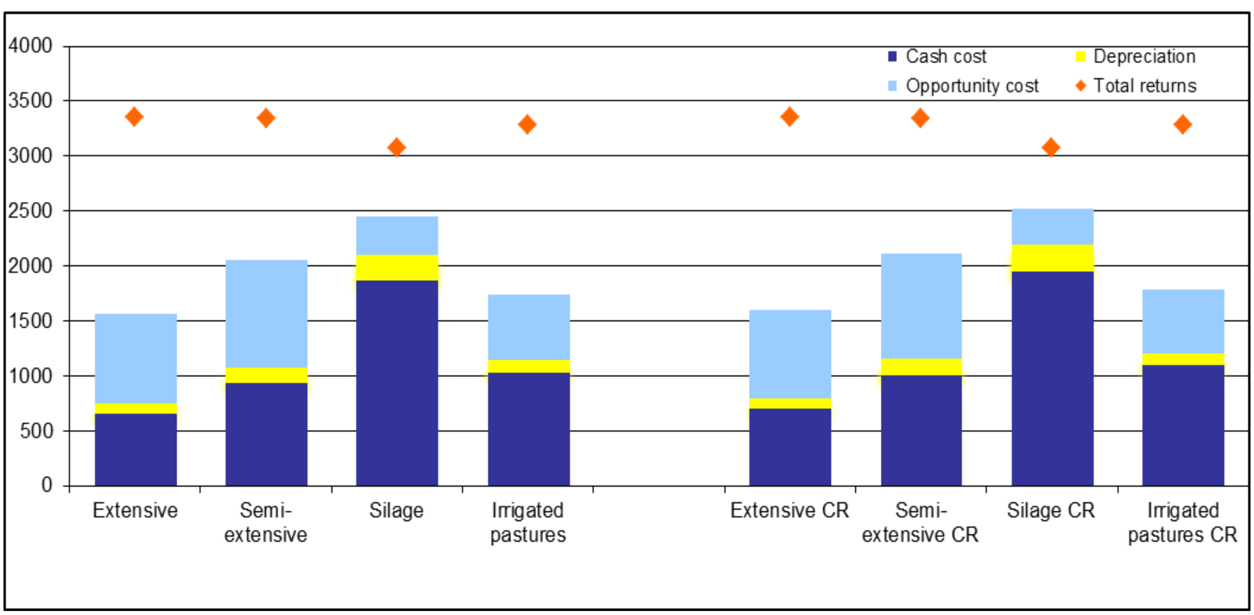


**Figure 4.26: Cash and non-cash cost, income and profitability (Rand/100kg LW)**

The whole farm profitability used to decide which system has the highest profitability, is shown in Figure 4.27. It contains the market returns and the total cost from the profit-and-lost account (P&L account). It is calculated with the following formula from Chapter 2:

Net Cash Farm Income (NCI) = Total Returns (TR) – Total Expenditures (TE)

NCI = Ewe returns (ER) – (Crop & Forage variable expenses (C/FVE) + ewe variable expenses (EVE) + Fixed expenses (FE) + Labour expenses (LaE) + Land expenses (LE) + Interest paid (I))

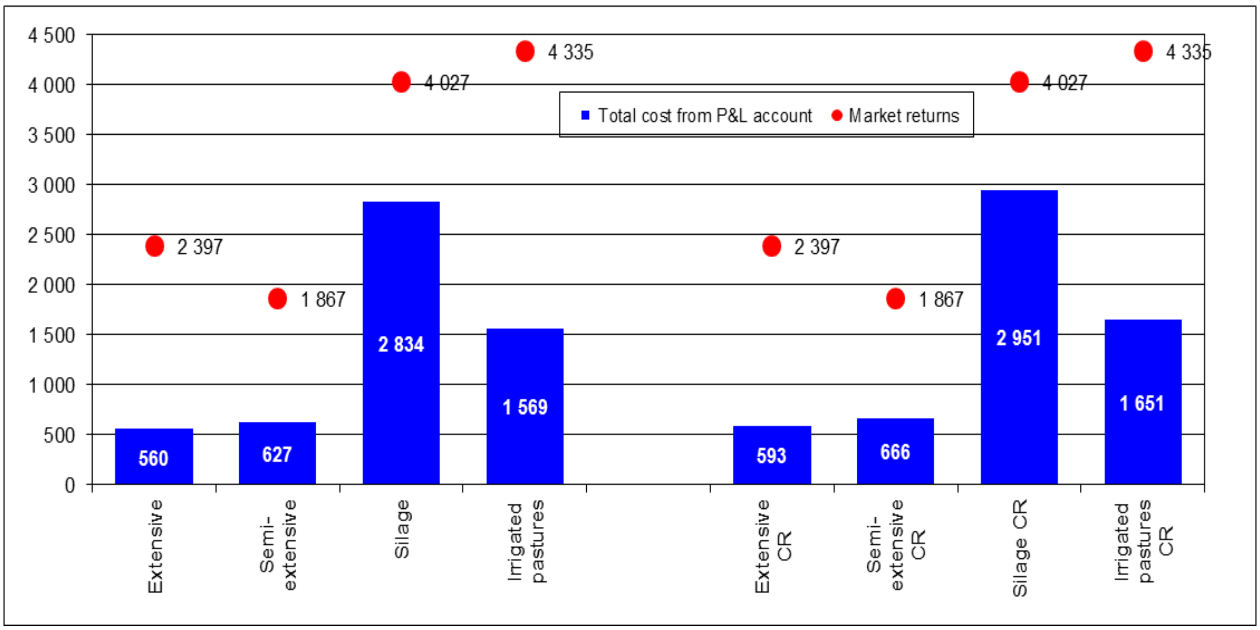


**Figure 4.27: Whole farm profitability (R1000 per farm)**

The four sheep production systems are rank below from the highest whole farm Net Cash Farm Income (NCFI), with the irrigated pasture system with the highest NCFI, despite its third lowest profit margin in Figure 4.4. The difference must have been its economy of scale over the two extensive sheep production systems having carried more sheep per hectare.

1. Irrigated pasture system R2 766 000

2. Extensive system R1 837 000

3. Semi-extensive system R1 240 000

4. Silage system R1 193 000

The intensive systems, irrigated pastures and silage, have the highest market returns/income, but also the highest total costs (P&L account). The net cash farm income (NCFI) levels of the four systems and the average total capital invested per system is shown in Table 4. Figure 4.28 contains the comparison of the Returns on investment/capital of the different systems.

**Table 4: Return on investment and average capital invested**

| | Extensive | Semi-extensive | Silage | Irrigated pastures |
|---|---|---|---|---|
| **NCFI** | 1837000 | 1240000 | 1193000 | 2766000 |
| **Average Capital invested** | 719000 | 840000 | 2477160 | 1761000 |
| **Return on Investment** | 255 | 148 | 48 | 157 |

The highest capital investment was made for the silage system at R 2 477 160.00. Capital for this discussion includes machinery, equipment and buildings but exclude land. The assumption was made that the land is available and paid for. The irrigated pasture also has a high capital investment of R1 761 000.00 with the main portion of that being the pivot. The main capital goods from the silage system were the pivots and the machinery and buildings for silage production. The extensive system has the lowest capital invested as was expected.

The irrigated system had the highest whole farm profitability of all the sheep systems at R 2 766 000.00. Profit however, is not the best criterion of efficiency. Efficiency is measured with profitability brought into connection with the capital invested into the sheep production system. The system with the best return on total capital investment

(ROC) (land, machinery, building and equipment) is the irrigated pasture system with a ROC of 40%. This means that the irrigated pasture system has a NCFI of R40 per R100 total capital invested in the system. The silage system has the second best ROC of 20% despite its lowest whole farm profitability (Figure 4.27). The extensive system has the lowest return on total investment. Figure 4.28 also shows return on investment, which exclude capital of land (the farm). The high percentage that land capital makes out of the total investment/capital of the two extensive systems is clear. The extensive system has by far the best return on investment if the land capital is excluded, followed by the irrigated pasture system (Figure 4.28). The irrigated pasture system shows constantly that it is the best system and compares well if it is not the best for a specific variable. The best sheep production system when looked at the profitability and efficiency is the irrigated pasture sheep production system.

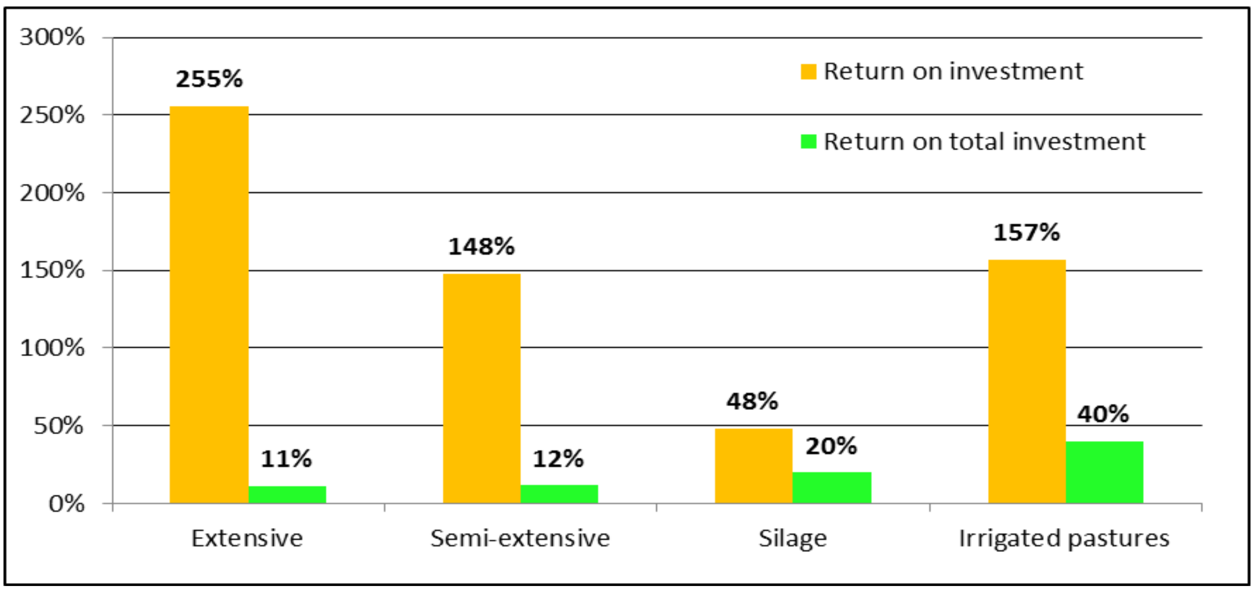


**Figure 4.28: Return on investment and total investment (land included) (%)**

# CHAPTER 5
# Conclusions and Recommendations

## 5.1 Introduction

This study focussed mainly on the evaluation of sheep production systems with regard to their profitability and efficiency. The amount of variables, variety of sheep production systems and the number of different combinations of sheep production systems are innumerable. The study focussed on central South Africa to investigate four different sheep production systems of which two were intensive systems, using irrigated pastures or silage respectively to produce mutton and wool. The silage for sheep especially, is a relatively new concept not used at this stage, that often, for sheep production. The irrigated pastures were used previously by individual farmers but the growing interest in irrigated pastures during the last five years for sheep production supported the need for this study. These intensive systems are further compared to an extensive system with rangeland only and a semi-extensive system with rangeland supported by irrigated pastures.

## 5.2 Choice of the *Agri Benchmark* methodology

The methodology used was the same as being used by the international *Agri Benchmark* project. It is a standardised methodology that uses the method of constructing typical farms for a production system. These typical farms as a sampling method have a lot of strong characteristics supporting it to be a strong sampling method for collecting farm data. The method is representative, there is consistency in the data sets, data is confidential and the cost of collecting data through typical farms was a lot lower. The confidentiality of the data may perhaps contribute to farmers being more open and honest about their figures and increase their participation. It also allows for the possibility of using the data for future research when benchmarking South Africa's sheep production systems nationally and internationally.

## 5.3 Meeting the objectives of this study

The results from the evaluation of the sheep production systems have a dual purpose. First it sketches the background and further detail of each system by comparing different variables with each other. Secondly, it provides information to evaluate the four systems in terms of the objectives stated in chapter one. The most important objective is the evaluation of profitability and efficiency.

The intensive systems, irrigated pastures and silage, have the highest market returns, but also the highest total costs. The whole farm profitability (NCI levels) of the four systems compares as follows (Ranked from highest to lowest):

1. Irrigated pasture system R2 766 000
2. Extensive system R1 837 000
3. Semi-extensive system R1 240 000
4. Silage system R1 193 000

The intensive sheep production system using irrigated pasture is the system with the highest profitability (Figure 4.27), followed by the extensive sheep production system. The intensive sheep production system with silage as the main fodder source, showed the lowest whole farm profitability. The silage system might have a higher turnover but the feeding cost of the system place enormous pressure on the profit margins of the system. The lower margin of profitability also leaves less room for the effect of price movements of inputs or meat- and wool prices. The importance of very high standards of management especially for the silage system's feeding inputs, cannot be over emphasised.

The irrigated pasture system outperformed the other systems in almost every measurement. Weaning percentage was the highest resulting in this system selling the highest total live weight per ewe. The whole farm profit margin compares well with the extensive systems. The weaning age is also the best, closely followed by the silage system. Wool income is also the highest, despite its percentage of the total income being the same as the extensive system. The higher wool income is directly correlated to the higher stocking rate of the irrigated pasture system.

The question was asked: What will the ROC (return on capital investment) of each system be? The decision for the investor or farmer will be whether he should invest in the particular production system or invest his capital in another investment portfolio. The irrigated pasture system again was the best in terms of ROC on 40% with the rest of the systems ranked as follows:

1. Irrigated pasture system 40%

2. Silage system 20%

3. Semi-intensive system 12%

4. Extensive system 11%

The main conclusion is that the sheep production system on irrigated pasture in this study has done the best in terms of profitability (NCFI) and efficiency (ROC). The profitability of the extensive sheep production system were the second highest, but the lowest when looked at return on capital invested due to the large proportion of land capital in the system. The silage sheep production system on the other hand was the lowest in whole farm profitability but second in returns on capital invested.

The whole study's aim was to serve as a tool to identify the critical management issues for intensive sheep production systems. The short result is: Management; the management of feed costs and the effective usage of the machinery. Planning and research is of the utmost importance when entering a new system. The potential of increased sheep production is promising on irrigated pasture systems. It will cost some management, but even the silage system with its lowest profit margin can be used to increase total income and will be an option for investors looking for return on capital invested.

Feeding costs are the biggest contributor to non-factor costs. This phenomenon is supported by Geyer *et al.* (2010) with feeding contributing the most to direct allocatable variable costs. The availability of fodder from the two extensive production systems is mainly a function of the climate conditions with the result a lower stoking rate and weaning percentage compared to the intensive sheep systems.

## 5.4 Recommendations

The sheep production systems studied in this research can ideally be used for further evaluations and research as part of the National and International *Agri Benchmark* project. The sheep analysis, using the tools of *Agri Benchmark* is still a new project as it was only developed during 2008 with the first application in South Africa in 2010. South Africa is busy building a national *Agri Benchmark* network and these systems can be added in the future. The data was collected with the same methodology and can add great value to the local network. It will broaden the views and understanding of participants in the sheep (mutton, lamb as well as wool) value chains and it is embedded in national and international markets. The results from a national *Agri Benchmark* network can also enhance the understanding of production systems and their drivers, both nationally and globally.

The results shown that irrigated pastures performed the best on profitability, but there are more irrigated pasture system variations used for sheep production that can be tested and benchmarked. An example of such a study can be the comparison of sheep production on four different pasture variations. Future research on stocking rates of irrigated pastures can be used with this study to support new research trying to measure the amount of ewes per hectare to be at the breakeven point. Thus, calculating the breakeven point in terms of ewes needed for each sheep production system. This to support investors needing to make a decision on the size of their investment and will it be viable to start a irrigated pasture system, stocked at 15 ewes per hectare or should the lowest stoking rate be not less than 19 ewes for example. The effect of policy changes on these systems from the study can be studied and if favourable can be used to engage with policy makers to the advantage of the whole sector and industry. Policy changes can also be analysed using *Agri Benchmark*.

**References:**

ABSA Group Economic Research, 2003. Game Ranch Profitability in Southern Africa. SA Financial Sector Forum, Rivonia. Retrieved at www.finforum.co.za on December 18, 2012.

Acocks JPH (1953). Veld types of South Africa. Memoirs of the Botanical Survey of South Africa 28: 1-192.

Anonym A (2013): Map of the study area in Central South Africa. Retrieved at http://maps.google.co.za on January 17, 2013.

Anonym B (2011): Agri Benchmark Beef Training. Model training - Part 1. Introduction/What is agri benchmark. Semmering, Austria – June 2011. Retrieved at www.agribenchmark.org on January 22, 2013.

Anonym C (2011): Agri Benchmark Beef Training. Model training - Part 2. Model structure. Semmering, Austria – June 2011. Retrieved at www.agribenchmark.org on January 22, 2013.

Anonym D (2009). Agriculture, forestry and land of South Africa. Retrieved at www.southafrica.co.za

ARC (undated). Agricultural Geo-Referenced Information System. Retrieved at www.agis.agric.za on January 15, 2013.

Archibald KP, Basson WD, Breytenbach WAS, Dickinson EB, Els JM, Hyam GFS, Metcalf HD, Plint AP, Scheepers LJ, Smith HRH, Smith PJ, Van Vuuren PJ, Viljoen JH & Williams FR (2007). *Weidingshandboek. Gewasse, Bestuur & Diereproduksie*. Kejafa Knowledge Works. IDS-Johannesburg.

Arceneau JD (Undated). Pasture management, Lesson 6. University of Minnesota, Extension Service. Retrieved at www.extension.umn.edu on October 20, 2011.

Arnold GW (1966a). The special senses in grazing animals, I. Sight and dietary habits in sheep. Australian Journal of Agricultural Research 17. P. 521-529.

Arnold GW (1966b). The special senses in grazing animals, II. Smell, taste, touch and dietary habits in sheep. Australian Journal of Agricultural Research 17. P. 531-542.

Barry PJ, Ellinger PN, Hopkin JA and Baker CB (1995). Financial Management in Agriculture. Interstate Publishers, Inc. Danville, IL. 213-237.

Bartholomew PE, Du Plessis TM & Macdonald CI (1991). Production and utilisation of pasture foggage. Department of Agricultural Development: Natal Region. Retrieved at http://agriculture.kzntl.gov.za on September 16, 2011.

Bartlett B (2004). The ABCs of Pasture Grazing. LPES Small Farms Fact Sheet series. Michigan State University.

Bath G, Van Wyk J & Malan F (2007). Holistiese bestuur van interne parasiete by skape en bokke. *Landbouweekblad*, 7 November 2007. Fakulteit Veeartsenykunde & Intervet.

Bell B (1997). Feeding Sheep Corn Silage. Government of Ontario. Retrieved at http://www.omafra.gov.on.ca on August 24, 2011.

Beukes PC, Palliser CC, Macdonald KA, Lancaster JAS, Levy G, Thorrold BS & Wastney ME (2008). Evaluation of a Whole-Farm Model for Pasture-Based Dairy Systems. Journal of Dairy Science, 91 (6). p. 2353-2360.

Bezuidenhout AG (1984). Die benutting van lusern onder besproeiing vir Intensiewe Merinoskaapproduksie. *Karoo Agric* 3 (3), p. 3-6.

Bezuidenhout AG (1987). Intensiewe Merinoskaapboerdery op besproeiingslande. *Karoo Agric* 3 (7), p. 13-14

Bezuidenhout AG (1987). Die voedingswaarde en benutting van lusern vir Intensiewe Kleinveeproduksie. *Karoo Agric* 3 (10), p. 26-30.

BFAP (2012). BFAP Baseline Agricultural Outlook 2012-2021. Retrieved at www.bfap.co.za on November 7, 2012.

Botha P, Blom CD, Sykes E & Barnhoorn ASJ (1983). Comparison between diets of small and large stock on mixed Karoo veld. Proceedings Grassland Society Southern. Africa. 18, 101-105.

Botha PR & Oberholzer T (1997). Vergelyking van ses weidingstelsels (kombinasies van besproeide en droëlandweidings) in die Outeniquagebied. *Elsenburg Joernaal no 1, 1997*. p. 44-49.

Botha PR (2003). Die produksiepotensiaal van oorgesaaide kikoejoeweiding in die gematigde kusgebied van die Suid-Kaap. Ph.D (Agric) – Proefskrif, Universiteit van die Vrystaat, Bloemfontein.

Botha P (2009). Factors influencing the persistence and production potential of Kikuyu (Pennisetum clandestinum) over-sown with different ryegrass and clover species in the southern Cape. Institure for Plant Production, Outeniqua Experimental Farm.

Botha T (2009). Probleem veel groter as veediefstal. *Landbouweekblad*, p. 62.

Botha P (2012). Goeie bestuur verhoog winterweidingproduksie. Retrieved at www.knysnaplettherald.com on January 9, 2013.

Brand G (2007). Pulpey kidney. Elsenburg veterinary services. Retrieved at www.elsenburg.com on January 9, 2013.

Breytenbach P, Meiring JA & Oosthuizen LK (1996). Die belangrikheid van elektrisiteitskoste by besproeiingsboerdery. Water SA, Vol. 22, no.4 October 1996, p. 333-338.

Broner I (2005). Irrigation Scheduling. Retrieved at www.ext.colostate.edu on January 10, 2013.

Calldo G, Melville J & Calldo T (undated). Kleinveebestuur. CMW.

Castellaro G, Gompertz G, Aquilar C, Vera R & Allende R (2006). Interaction of two simulation models for the evaluation of sheep production systems in the Mediterranean-type Region of Chile. Ciencia Investigacion Agraria, 33 (1). p. 41-49.

Clayfield S (2011). Buying Merino Rams – Making the meausurements useful. Retrieved at www.dpi.vic.gov.au on November 1, 2012.

Cloete SWP, Cloete JJE, MJ Herselman & Hoffman LC (2004). Relative performance and efficiency of five Merino and Merino-type dam lines in a terminal crossbreeding system with Dormer and Suffolk sires. South African Journal of Animal Science 2004, 35 (3), p. 135-143.

Coblentz W (undated). Principles of Silage Making. University of Arkansas, Division of agriculture, Cooperative Extension Service. Retrieved at http://www.uaex.edu on August 24, 2011.

Cockrell JR (undated). Techniques for extending the grazing season. University of Wisconsin – Extension. Retrieved at www.uwrf.edu/grazing/ on August 24, 2011.

Coetzee J & Malan F (2008). Watter skaapras op aangeplante weiding? *Landbouweekblad,* 10 September 2008.

Coetzee J (2009). Kruipvoeding ononderhandelbaar vir winsgewende skaapproduksie. Retrieved at www.voermol.co.za on November 25, 2012.

Coetzee J (2010). Riglyne vir Skaapboerdery op aangeplante weiding. Retrieved from www.landbou.com on November 14, 2012.

Coetzee J (2011). Fokus op doeltreffendheid vir volgehoue winsgewende wolskaapboerdery. *Merino focus 2011*, p 52-56.

Coetzee J (2012). Toekoms van winsgewende Skaapboerdery lê in toenemende intensivering. *Wolboer* (NWKV uitgawe), Mei 2012, p. 6.

Corson MS, Rotz CA & Skinner RH (2007). Evaluating warm-season grass production in temperate-region pastures: A simulation approach. Agricultural systems, 93. p.252-268.

Cuomo G (1999). Nitrogen management for grass pastures. University of Minnesota, West Central Research and Outreach Center. Retrieved at http://www2.uwrf.edu/ on June 20, 2011.

Curtis A & O'Brien G (1994). Pasture management for dairy farmers. Victorian Department of Agriculture, 166 Wellington Parade, East Melbourne 3002, Victoria, Australia. p. 3-57.

Davies L & Deblitz C (2010). Agri Benchmark Sheep Report 2010, Benchmarking Farming Systems around the World. vTI, Braunschweig.

Deblitz C (2008). Agri Benchmark Beef Report 2009, Benchmarking Farming Systems around the World. vTI, Braunschweig. Available on the Internet at http://www.agribenchmark.org/beef_results_farm_beef_reports.html

Deblitz C (2009). Agri Benchmark Beef Report 2009, Benchmarking Farming Systems around the World. vTI, Braunschweig. Available on the Internet at http://www.agribenchmark.org/beef_results_farm_beef_reports.html

Deblitz C (2010). Benchmarking Beef Farming Systems Worldwide. Conference Paper 54th AARES Conference 2010, Adelaide, Australia. An overview of agri benchmark. P.1-21.

Deblitz C (ed.) (2010a). Agri Benchmark Beef and Sheep Report 2010 – Selected results for the season 2009/2010, vTI Braunschweig.

Deblitz C (2011). A new dimension for the analysis of the beef sector. Working paper 1/2011-Part 2. Retrieved at www.agribenchmark.org on January 15, 2013.

Deblitz C (2012). SA bied ruimte vir verbetering. *Landbouweekblad*, 6 Julie 2012, p. 93.

Deblitz C, Charry AA & Parton KA (2003). Beef farming systems across the world: an expert assessment from an international co-operative research project (IFCN). Extension Farming Systems Journal volume 1:1 – Research Forum. Retrieved at www.csu.edu on January 26, 2013.

Deblitz C & Zimmer Y (2007). *Agri Benchmark Beef*: A standard operating procedure to define typical farms. Braunschweig: FAL, 20 pages. Available on the Internet at http://www.agribenchmark.org/beef_typical_farms_definitions.html

De Kock T (2004). South African Livestock Breeding 2004. Picasso Headline, Cape Town. p.104-105.

Directorate (2006). Estimated livestock numbers – February 2006. National Department of Agriculture.

Donaldson CH (2001). A Practical Guide to Planted Pastures. Kalbas Publishers, Cape Town, South Africa.

Dickinson EB, Hyam GFS & Breytenbach WAS (1990). Die Kynoch weidinghandleiding, CTP Boekdrukkers, Kaapstad. CD – R100.

Donnelly JR, Freer M & Christian KR (1987). GRASPLAN: A computer-based management package for agricultural production systems. Conference Proceedings of the Simulation Society of Australia RMIT, p. 313-318.

Du Plessis TM (undated). Pasture management, Problems on pastures: Pitfalls and pointers. Department of Agricultural Development: Natal Region. Retrieved at http://agriculture.kzntl.gov.za on September 10, 2010.

Duras (2008). Karoo Lamb Case Study. Duras project. Retrieved at www.elsenburg.com on January 6, 2013.

Du Preez J & Malan F (2006). Entstowwe en immunisering van plaasdiere. Agri Connect, Pretoria.

Du Toit PCV, Blom CD & Immelman WF (1994). Diet selection by different small stock species in the arid Karoo. *Karoo Agric* 6 (1), 25-27.

Du Toit PCV (2000). Wat vreet verskillende Skaaprasse in die Dorre Karoo? *Grootfontein Agric* 2 (2), 12-13.

Du Toit H (2008). Hoe om aangeplante weidings optimaal te bestuur. Noordwes Nuus Jan/Feb 2008 Jaargang 40.

Esmail SHM (1991). Multispecies grazing by cattle and sheep. *Rangelands*. 13(1):35-37.

Fair J (1989). John Fair's Guide to Profitable Pastures / Gids tot winsgewende weiding, Second edition. M & J Publications, Harrismith.

Feedbase (2007). Perennial pastures in cropping rotations – a discussion paper for Grain and Graze. National Feedbase project team. Retrieved at www.grainandgraze.com on January 10, 2013.

Florence R (2002). Pasture FAQ. Retrieved at www.sheepcreek.com on December 23, 2012.

Frank GG (2000). Calculating production costs. University of Wisconsin, Madison. p. 1-6. Retrieved at http://www.uwex.edu

Gerrish J (2006). Management-intensive Grazing. The Grassroots of Grass Farming. Green Park Press, Mississippi.

Geyer AC & Van Heerden C (2009). The role of meat production in the wool sheep industry. *Merino Focus 2009* p. 74.

Geyer AC, Van Heerden C & Venter J (2011). Oorsig van Merino boerdery in die Calvinia omgewing. *Merino Focus 2011* p. 58-59.

Hall TJ, Silcock RG, Sevil JJ & Van der Meulen JR (1997). Improving pasture composition increases wool returns in Eucalypt Woodlands. Retrieved at www.internationalgrasslands.org on January 10, 2013.

Hofstrand D (2007). Farm Business Strategies. Retrieved at www.extension.iastate.edu.

Hofstrand D (2008). Livestock Protection-Specializing while retaining Income Diversification. Retrieved at www.extension.iastate.edu.

Hoon JH (2010). Vegetation and animal production in South Africa. Retrieved at www.gadi.agric.za on December 18, 2012.

Howell N & Martz F (1993). Corn silage. Departments of Agronomy and Animal Sciences. University of Missouri. Retrieved at http://extension.missouri.edu

Hutton G (2008). Silage production – Introduction. Government of Alberta. Retrieved at http://www1.agric.gov.ab.ca

Jennings J (2011). Principles of Silage Making. Agriculture and Natural Resources, FSA3052. Retrieved at www.uaex.edu on January 15, 2013.

Johnson RR & McClure KE (1968). Corn plant maturity. IV. Effects on digestibility of corn silage in sheep. Ohio Agricultural Research and Development Center, Wooster.

Kenney PA & Black JL (1984). Factors Affecting Diet Selection by Sheep. I. Potential Intake Rate and Acceptability of Feed. Australian Journal of Agricultural Research, 35. 551-563.

Kingwill G (2011). Wool industry challenges and opportunities. *Merino focus 2011*, 40-42.

Kirkman K (2011). Weidingsbestuur: Hoeveel en hoe goed? *Veeplaas*, Maart 2011, p.64-65.

Klug JR, Van Heerden JM & Lishman AW (1999). Fodder production planning and livestock production systems. In: Veldt Management in South Africa. Tainton NM (Ed), Natal University Press, Pietermaritzburg.

Labuschagne J (2005 A). Nitrogen Management Strategies on Perennial Ryegrass-White Clover Pastures in the Western Cape Province. PhD, University of Stellenbosch.

Labuschagne J (2005 B). Die strategiese toediening van stikstof op gras-klawerweiding kan dieweiding se produksie verbeter. Retrieved at www.landbou.com on June 10, 2011.

Landman G (2010). Hooimaak en ruvoeropberging. *Landbouweekblad*. 14 Februarie 2010.

Lauer J (2009). Key management practices for profitable corn silage production – Lessons learned selecting hybrids and harvest management. Paper presented at the Second International Meeting on Systems of Production of Forages and Milk. Guadalajara, Mexico, March 25-27, 2009.

Londt H (2010). Dohne Merino's verseker stabiliteit in die ekonomie van boerderystelsel onder besproeiing. Dohne Merino Journal 2010 Vol. 34 no 1. P17-21.

Londt H (2011). Wolskape klop mielies en koring op besproeiing. *Landbouweekblad*, 4 Februarie 2011, p. 18-19.

Louw L (2012). Ekonomies belangrike aspekte van Angorabokboerdery. Grootfontein. Retrieved at www.gadi.agric.za on December 10, 2012.

LPP (2006). Silage. Livestock Production Programme, DFID. Retrieved at http://www.smallstock.info on July 15, 2010.

Malan F (2010). Siektes en parasiete ingekoop in 'n skaapkudde. *Landbouweekblad,* 9 Augustus 2010.

Malan PJ (2009). Personal communication. Department of Animal Wildlife and Grassland Science, University of the Free State.

Martin (1960). The role of white clover in grassland. *Herbage Abstracts* 30. p. 159-164.

Maxwell D (2008). Internal Parasite Control in Sheep, Reference Manual. Retrieved at www.woolwise.com on November 2, 2012.

McCall DG & Bishop-Hurley GJ (2003). A pasture growth model for use in a whole-farm dairy production model. *Agricultural Systems*, 76. p. 1183-1205.

Meeske R (2011). Maak beter kuilvoer. *Veeplaas*, Maart 2011, p. 28-31.

Merino South Africa (2009). The history of Merino Sheep. Retrieved at http://www.merinosa.co.za/index.php/history-of-merino-sheep

Moore G, Sanford P & Wiley T (2006). Perennial pastures for Western Australia. Department of Agriculture and Food Western Australia, Bulletin 4690.

Morley FHW (1987). A spreadsheet for sheep-production systems. In "Computer Assisted Management of Agricultural Production Systems", RMIT Melbourne. p. 82-85.

Morokolo B (2011). A Profile of the South African Mutton Market Value Chain. Retrieved at www.nda.agric.za on December 18, 2012.

National Department of Agricultural (2012). Abstracts for Agricultural Statistics of South Africa. Available on http://www.daff.gov.za/

Neary M (1992). Management of Ewes and Lambs at Weaning. Perdue Sheep Day Proc. Purdue University.

Neary M (1997). Preventing Pasture Bloat in Sheep. Extension Sheep Specialist, Perdue University, The Working Border Collie, Jan/Feb. 1997.

Nel JA (1980). Ekstensiewe Skaapproduksie. Suider-Afrikaanse Tydskrif vir Veekunde 10, p. 305-309.

Nel E & Hill T (2007). Marginalisation and demographic change in the semi-arid Karoo, South Africa. Retrieved at www.ru.ac.za on December 18, 2012.

Nel C, Van Pletzen H & Izak Groenewald (2010). Skaapproduksie op Meerjarige Besproeide Weidings. Retrieved at www.lanbou.com on May 17, 2012.

Nell W, Hugo H & Mokhatla P (2011). Strategiese Bestuursaspekte van ‘n Merinoboerdery. Merino Focus 2011 p. 70-75.

Paine L (2001). Pasture Fertilization: Dealing with the High Price of Nitrogen. Agri-View 23. Retrieved at http://www2.uwrf.edu/

Palmer T & Ainslie A (2002). Country Pasture/Forage Resource Profiles, South Africa. Retrieved at www.fao.org on January 5, 2013.

Pannar (undated). Weidings Produksiehandleiding. Pannar Saad (Edms) Bpk, Greytown. Retrieved at www.pannarseed.co.za on January 7, 2013.

Pienaar A (2010). Personal Communication. MEGA MERINOS Klipplaatsfontein, Colesberg.

Pocket Guide to South Africa (PGSA) (2010). National Department of Agricultural South Africa. Retrieved at http://www.gcis.gov.za

Poonyth D, Hassan R & Kirsten JF (2001). Random coefficients analysis of changes in meat consumption preferences in South Africa. *Agrekon*, Vol 40, No.3. September 2001, p. 426-437.

Rickert KG (1988). Computer models and the study of grazing systems. Tropical Grasslands Vol. 22, 4. p. 145-149.

Roeder B (2007a). Pasturing irrigated land with sheep. Montana Sheep Institute Retrieved at http://www.msuextension.org on June 11, 2010.

Roeder B (2007b). Running sheep on Irrigated Pasture: Some Commonsense and Producer Experiences. Montana Sheep Institute Retrieved at http://www.msuextension.org on June 10, 2010.

Ronan G & Cleary G (2000). Best practice benchmarking in Australian agriculture: Issues and challenges.

Rotz CA, Mertens DR, Buckmaster DR, Allen MS & Harrison JH (1999). A dairy herd model for use in whole farm simulations. Journal of Dairy Science 82. p. 2826-2840.

SA Info (2008). South Africa info: South African's farming sectors. Retrieved at http://www.southafrica.info/business/economy/sectors/542547.htm#livestock

Scheepers L (2005). Diereproduksie vanaf aangeplante weidings in die sertrale somersaaigebied. 'n Praktiese handleiding vir droëland en besproeiing. *Kejafa Knowledge Works, Paarl Print, Kaapstad.*

Schoenian S (2010). Creep feeding primer. Small Ruminant Info Sheet website. Retrieved at www.sheepandgoat.com on 07/12/12.

Schuster DJ & Luening RA (2003). Dairy Sheep Enterprise Budget: Suggestions for Use. University of Wisconsin-Madison College of Agricultural & Life Sciences.

Schutte F (2008). Skaapproduksie. Kejafa Knowledge Works, Silver Signs & Print, Pretoria.

Seib A (2009). Ranching with sheep. Where Land, Passion and Profit meet. Retrieved at www.ranching-with-sheep.com on December 14, 2012.

Sheep CRC (2006). Profitability of sheep enterprises in Southern Australia. p. 1-5. (Australian Sheep Industry Cooperative Research Centre, www.sheepcrc.org.au)

Sleugh B, Moore KL, George JR & Brummer EC (2000). Binary legume-grass mixtures improve forage yield, quality and seasonal distribution. Agronomy Journal 92, 24-29.

Smith JM (1999). Beef and Sheep Production Systems. KwaZulu-Natal Veld 2.6. Retrieved at www.agriculture.kzntl.gov.za on January 15, 2013.

Smith SR (2000). Preventing Bloat on Pasture. Canadian Journal of Plant Science.

Smith M (2004). Aangeplante weiding bly betalend. *Landbouweekblad*, 30 Julie 2004. Retrieved at www.landbou.com on 14/09/2012.

Smith T (2007). To better manage irrigated pasture; Avoid common mistakes. *Angus Journal*, February 2007, p. 200-201.

Snyman MA & Herselman MJ (2005). Comparison of productive and reproductive efficiency of Afrino, Dorper and Merino sheep in the False Upper Karoo. *South Afican Journal of Animal Science* 2005, 35 (2), p. 98-108.

Snyman HA (2012). Gids tot die volhoubare produksie van weiding. Alles oor Natuurlike veld & aangeplante weiding vir Kleinvee-, grootvee- & wildboere. Pannar. Rosebank Media, Kaapstad.

Southey R (2011). Mega success with Merinos. *Farmer's weekly*, 17 June 2011, 52-54.

Spedding CRW (1988). General aspects of modelling and its application in livestock production. In: Korver S and van Arendonk JAM (Eds). Modelling livestock Production systems, 3-9. Kluwer Academic Publishers

Stout WL (1994). Evaluation of the SPUR model for grasslands of the north eastern United States. Agronomy Journal, 86. p.1001-1005.

Swart L (2010). Skape: Meerlinge beteken meer wins. *Landbouweekblad*, 26 November 2010, p. 22-23.

Tainton N (1999). *Veld management in South Africa*. University of Natal Press, Pietermaritzburg.

Taljaard PR (2003). Econometric estimation of the demand for meat in South Africa. M. Sc., University of the Free State.

Thedford TR, Crutcher B, Hughes J & Fitch G (undated). Sheep Health and Management. Oklahoma Cooperative Extension Service, Oklahoma State University.

Thomson EF, Bahhady FA, Nordblom TL & Harris HC (1995). A model farm approach to research on Crop-Livestock integration-III. Benefits of Crop-Livestock Integration and a critique of the approach. *Agricultural Systems*, 49, pp. 31-44.

Truter W & Dannhauser C (2011). Revitalizing Planted Pastures in South Africa. *Grassroots*, Vol. 11 No.3, p. 20-23.

Uddin MM, Sultana MN, Ndambi OA, Hemme T & Peters KJ (2010). A farm economic analysis in different dairy production systems in Bangladesh. Livestock research for Rural Development 22 (7). Retrieved at www.lrrd.org on January 26, 2013.

Undersander D (2001). Bloat. University of Wisconsin-Extension Cooperative Extension. Retrieved at http://www.uwex.edu

Van As H (2012). Verbeter moedereienskappe met ‘n lamhokstelsel. *Veeplaas*, Desember 2012, p. 45.

Van Niekerk W, Taljaard P, De Waal HO (2009). Die impak van predasie op kleinvee in Suid Afrika. *RPO Nuusbrief.* Junie 2009.

Van Niekerk W (2010). *The cost of predation on small livestock in South Africa by medium-sized predators*. Department of Agricultural Economics, University of the Free State.

Van Pletzen H, Melville J & Hanekom P (2006). Merinos Presteer goed in praktykproewe in die Suid-Vrystaat. Merino Focus 2006, p. 28-30.

Van Pletzen H, Nel C & Groenewald I (2011). Wen met skape op besproeide weidings. Landbouweekblad, 8 April 2011, p. 20-22.

Van Pletzen H (2011). Vertical expansion of sheep farming through irrigated pastures and precision breeding. Retrieved at www.voermol.co.za on November 23, 2012.

Van Zyl J, Kirsten JF, Coetzee GK & Blignaut CS (1999). Finansiering en die Boer: ‘n Finansiële bestuursgids vir boere. Die landbou-afdeling, Die Standard Bank van Suid-Afrika Beperk. Magicprint.

Van Wyk JA (2006). Kan wurmbesmetting ‘n projek met skape op besproeide aangeplante weiding in die wiele ry. Departement Veterinêre Tropiese Siektes, Fakulteit Veeartsenykunde, *Landbouweekblad*, 7 April 2006.

Vink N (2009). The global sheep industry. *Merino Focus 2009* p.28-32.

Warn L, Ware JW, Salmon L, Donnelly J & Alcock D (2006). Profitability of sheep enterprises in Southern Australia. Sheep CRC, Practical Wisdom. Retrieved at www.sheepcrc.org on January 5, 2013.

Warren SD, Thurow TL, Blackburn WH & Garza NE (1986). The influence of Livestock Trampling under Intensive Rotation Grazing on Soil Hydrologic Characteristics. Journal of Range Management, Vol. 39, No.6, 491-495.

Wells A (2010). Preventing animal health problems is the key to certified organic animal health problems. Retrieved at http://www.stockmangrassfarmer.net

Wessels HW (2011). ‘n Ondersoek na die ekonomiese volhoubaarheid van semi-intensiewe en intensiewe Skaapboerdery in die Oostelike Hoëveld streek van Suid-Afrika. Fakulteit Natuur- en Landbouweterskappe, Universiteit van die Vrystaat.

Woodford K (1985). Electronic spreadsheets and farm planning. In “The Application of Computer Models in Farm Management, Extension and Research”. AIAS Refresher Training Course, QAC, Lawes). p. 1.4.1.-1.4.7.

Zimmer Y, Leibold K, Rego J, Van der Westhuizen D & Schoney R (2011). Costs of Production for selected Commodities. Estimation of National Cost Share Structures based on Agri Benchmark Data. Retrieved at www.agribenchmark.org on January 19, 2013.

# Appendix A

## TIPICAL Questionnaire

agri benchmark Beef

| | |
|---|---|
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- Print whole content
- Print content page
- Print whole farm section
- Print crop and forage section
- Print dairy section
- Print beef section
- Print cow-calf content
- Print lamb finishing section
- Print ewe section
- Print emission section

Content



## 1 Whole Farm Data

1.1 - 1.8

1.1

### 1.1 Overview

**What are the main characteristics of a typical farm in your region?**

| | | | | | |
|---|---|---|---|---|---|
| Country | | | Natural region | | |
| Region | | | Relief (hills, upland, plains) | | |
| Currency | | | Elevation (m above sea leavel) | | |
| | | | Soil composition | Clay loam | |
| Legal Status of the Enterprise | | | Climate | BS - dry semiarid (steppe) | |
| | | | Main growing season | | |
| Reference Year of the following Data | | | Average annual temperature (° Celsius) | | |
| | | | Average annual precipitation (mm) | | |
| **Enterprises** | | | Precipitation distribution | | |
| Cash Crops | | yes/no | | | |
| Beef finishing | | yes/no | | | |
| Cow-calf | | yes/no | | | |
| Dairy | | yes/no | Ewes | | yes/no |
| Other (specify) | | text | Lamb finishing | | yes/no |
| Values including / without VAT | | | | | |

### 1.2 Machinery and Equipment

1.2
to line 215

| | | |
|---|---|---|
| Annual Machinery Depreciation ( c ) | | Sum of all depreciation values of all machines. Can be found in the inventory list of your accounting. |
| Machinery Book Values ( c ) | | Sum of all machinery book values in the start year. Often corresponds with the residual value. |

| Machinery List | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| | Year of | Purchase price | | Utilization Period | Salvage Value | Replacement | Repl. value | |
| | purchase | C / piece | for tax | economically | C / piece | yes/no | C / piece | Enterprise codes |
| **Tractors** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Tillage** | | | | | | | | |
| **Harvest and Transport** | | | | | | | | |
| **Forage Harvesting Equipment** | | | | | | | | |
| **Feeding and Milking Equipment** | | | | | | | | |
| **Other Machinery and Equipment** | | | | | | | | |
| | | | | | | | 1.2<br>from line 215 | |

## 1.3 Buildings and Facilities

1.3

| | | |
|---|---|---|
| Annual Depreciation on Build. & Facil. ( c ) | | Sum of all depreciation values of all buildings. Can be found in the inventory list of your accounting. |
| Building & Facilities Book Values ( c ) | | Sum of all building book values in the start year. Often corresponds with the residual value. |

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| | | Purchase price | | | | | | |
| | Year of | or book value | Utilization Period | | Salvage Value | Replacement | Repl. value | Enterprise codes |
| | purchase | C / piece | for tax | economically | C / piece | yes/no | C / piece | |
| **List of Buildings and Facilities** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

## 1.4 Labour input and wages

1.4 + 1.4.1 + 1.4.2 | 1.4 | from line 338 | from line 364

| Permanent labour | A<br>Labor Units<br>Number | B<br>Working hours per<br>person and year | C<br>Annual Wage/Person incl.<br>Side Costs | | D<br>Enterprise codes |
|---|---|---|---|---|---|
| Group I | 0.00 | 0 | 0 | | 0 |
| Group II: Executive Staff/herdsmen | 0.00 | 0 | 0 | | 0 |
| Group III: Tractor Driver | 0.00 | 0 | 0 | | 0 |
| Group IV: Cattleman / Milker | 0.00 | 0 | 0 | | 0 |
| Group V: | 0.00 | 0 | 0 | | 0 |
| Group VI: | 0.00 | 0 | 0 | | 0 |
| **Casual Labour** | 0.00 | 0 | 0.00 | (wages per hour, not per year) | |
| **Family Labour** | 0.00 | 0 | 0.00 | (wages per hour, not per year) | 9 |

### 1.4.1 Hours worked per worker

| | A | B | C1 | C2 | C3 | D1 | D2 | D3 |
|---|---|---|---|---|---|---|---|---|
| | No. of | | Total weeks available 52 weeks per year | | | | | |
| | workers | Leave | Regular work | | | Labour peaks | | |
| **Permanent labour** | | weeks | weeks | days per week | hours per day | weeks | days per week | hours per day |
| Group I | | | | | | | | |
| Group II: Executive Staff/herdsmen | | | | | | | | |
| Group III: Tractor Driver | | | | | | | | |
| Group IV: Cattleman / Milker | | | | | | | | |
| Group V: | | | | | | | | |
| Group VI: | | | | | | | | |
| **Casual Labour** | | | | | | | | |
| Casual labour 1 | | | | | | | | |
| Casual labour 2 | | | | | | | | |
| Casual labour 3 | | | | | | | | |
| Casual labour 4 | | | | | | | | |
| Casual labour 5 | | | | | | | | |
| Casual labour 6 | | | | | | | | |
| **Family Labour** | | | | | | | | |
| Family member 1 | | | | | | | | |
| Family member 2 | | | | | | | | |
| Family member 3 | | | | | | | | |
| Family member 4 | | | | | | | | |
| Family member 5 | | | | | | | | |
| Family member 6 | | | | | | | | |

### 1.4.2 Salaries and allocation codes

| | A1 | A2 | B1 | B2 | B3 | B4 | C |
|---|---|---|---|---|---|---|---|
| | | Salary | Allocation to | Allocation to | Allocation to | Allocation to | Enterprise |
| | per year | per hour | beef finishing | cow-calf | lamb finishing | ewe | codes |
| **Permanent labour** | US$ | US$ | 0,0x | 0,0x | 0,0x | 0,0x | 1-10 |
| Group I | | | | | | | |
| Group II: Executive Staff/herdsmen | | | | | | | |
| Group III: Tractor Driver | | | | | | | |
| Group IV: Cattleman / Milker | | | | | | | |
| Group V: | | | | | | | |
| Group VI: | | | | | | | |
| **Casual Labour** | | | | | | | |
| Casual labour 1 | | | | | | | |
| Casual labour 2 | | | | | | | |
| Casual labour 3 | | | | | | | |
| Casual labour 4 | | | | | | | |
| Casual labour 5 | | | | | | | |
| Casual labour 6 | | | | | | | |
| **Family Labour** | | | | | | | |
| Family member 1 | | | | | | | |
| Family member 2 | | | | | | | |
| Family member 3 | | | | | | | |
| Family member 4 | | | | | | | |
| Family member 5 | | | | | | | |
| Family member 6 | | | | | | | |

## 1.5 Liabilities and Interest Rates

1.5 - 1.7

| **Current Interest Rates** | | | | |
|---|---|---|---|---|
| Long-term Loans | 0,0x | | | |
| Medium -term Loans | 0,0x | | | |
| Short-term Loans | 0,0x | | | |
| Circulating Capital (Overdraft) | 0,0x | | | |
| Savings | 0,0x | | | |
| **Total Liabilities** | C | | | |
| Total Long-term Loans | C | 0 | >8 years | Loan Period |
| Total Medium -term Loans | C | 0 | 4-8 years | Loan Period |
| Total Short-term Loans | C | 0 | 1-3 years | Loan Period |

## Option 2

| **Operating loans** | Initial value of the loan | Annual interest rate |
|---|---|---|
| | C | 0,0X |
| Values in start year | | |

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Initial value of the loan | Initial value of the loan | Purpose of the loan | Loan Period | Start year of the credit | Annual interest rate |
| text | C | text | years | Year | 0,0X |
| Loan 1 | | | | | |
| Loan 2 | | | | | |
| Loan 3 | | | | | |
| Loan 4 | | | | | |
| Loan 5 | | | | | |
| Loan 6 | | | | | |
| Loan 7 | | | | | |
| Loan 8 | | | | | |
| Loan 9 | | | | | |
| Loan 10 | | | | | |

## 1.6 Profit and Capital Structure

**Profit and Taxes (c / year)**

| | | |
|---|---|---|
| Profit in previous year | C / year | |
| Paid Income Tax | C / year | |
| Paid Corporation Tax | C / year | |

## 1.7 Information on Farm-Ownership (Taxes, Consumption, Private drawings)

**Information on Consumption Requirements (excl. Taxes)**

| | A | B | C | D |
|---|---|---|---|---|
| | Fix | Minimum | Maximum | ion payments to parents |
| | C / year | C / year | C / year | C / year |
| Partner 1 | | | | |
| Partner 2 | | | | |
| Partner 3 | | | | |
| Partner 4 | | | | |

## 1.8 Fixed Costs and Other Revenues of the Farm

1.8

**Fixed Costs**

| | | | |
|---|---|---|---|
| Land improvements | C / year | | Drainage etc. |
| Maintenance Machinery | C / year | | If not known, calculate proxy, e.g. 3 % of the purchase price per annum; avoid double counting! |
| Maintenance Buildings and Facilities | C / year | | If not known, calculate proxy, e.g. 1,5 % of the purchase price per annum; avoid double counting! |
| Contracted Labour, Machinery Association | C / year | | |
| Diesel for vehicles | C / year | | Includes Pick-up trucks, farm vehicles, NOT tractors for crop and forage production (var. cost per ha!) |
| Diesel for heating / irrigation | C / year | | |
| Gasoline | C / year | | |
| Gas | C / year | | |
| Electricity | C / year | | |
| Water (fresh * waste water fees) | C / year | | Water and energy for the farmstead, not for crop production and other enterprises |
| Farm Insurances | C / year | | Insurances to cover the farm, e.g. fire insurance, crop insurance under other variable cost crop |
| Invalidity insurance | C / year | | Fees for instutions that provide accident insurances and check safety on the farms |
| Taxes and Fees | C / year | | Only farm taxes like ground tax, no personal taxes like income tax! |
| Advisory Services / Trainings | C / year | | Costs for advisory/extension services if it cannot be allocated to the enterprises |
| Accounting | C / year | | E.g. costs for hiring a person or a company to do the accounting |
| Office, Communication, Subscriptions ... | C / year | | All kind of materials, hardware and communication expenses |
| other | C / year | | |
| other | C / year | | |

**Direct Payments to the Farm**

| | | |
|---|---|---|
| Payment for Less Favoured Areas (LFA) | C / year | |
| 0 | C / year | |
| 0 | C / year | |
| 0 | C / year | |
| 0 | C / year | |
| 0 | C / year | |

**Other Farm / Enterprise returns (relevant for farm profit)**

| | | |
|---|---|---|
| Tax-exempt | C / year | |
| Taxable | C / year | |

**Off-farm income**

| | | |
|---|---|---|
| Tax-exempt | C / year | |
| Taxable | C / year | |

# 2 Data on Crop and Forage Production

2.1 - 2.5

2.1

## 2.1 Available Acreage and Prices

| | | Cropland | Grassland | Other incl. wood |
|---|---|---|---|---|
| Own Land | ha | | | |
| Rented Land | ha | | | |
| Rent Price for old contracts | C / ha | | | |
| Rent Price for new contracts | C / ha | | | |
| Market Value | C / ha | | | |

## 2.2 Land use, Yields, Prices and direct payments

2.2

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| | Acreage | Net yield | Dry matter | Price | CAP dir. paym. | Other dir. paym. | Other dir. paym. | Enterprise codes |
| ** Please indicate Production Quota A/B/C | ha | t / ha | 0,0x | C / t | C / ha | C / ha | C / ha | |
| Set aside | | | | | | | | |
| Pastureland | | | | | | | | 9 |
| Grass silage | | | | | | | | |
| Hay | | | | | | | | |
| Grass on arable land | | | | | | | | |
| Maize silage | | | | | | | | |
| Winter wheat | | | | | | | | |
| Winter barley | | | | | | | | |
| Rye | | | | | | | | |
| Triticale | | | | | | | | |
| Straw | | | | | | | | |
| Winter rape | | | | | | | | |
| Peas | | | | | | | | |
| Potatoes | | | | | | | | |
| Sugarbeets ** | | | | | | | | |
| Total plants silage (cereals) | | | | | | | | |
| Rape on set aside | | | | | | | | |
| Oil linseed | | | | | | | | |
| | | | | | | | | |
| 0 | | | | | | | | |
| end 20 | | | | | | | | |

## 2.3 Variable Costs of Crop and Forage Production

2.3

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| | Seeds | Fertilizer | Herbicides | Fung./Ins. | Contract labor | Energy | Other * |
| | C / ha | C / ha | C / ha | C / ha | C / ha | C / ha | C / ha |
| | | | | | | Fuel/Lubr. | |
| Set aside | | | | | | | |
| Pastureland | | | | | | | |
| Grass silage | | | | | | | |
| Hay | | | | | | | |
| Grass on arable land | | | | | | | |
| Maize silage | | | | | | | |
| Winter wheat | | | | | | | |
| Winter barley | | | | | | | |
| Rye | | | | | | | |
| Triticale | | | | | | | |
| Straw | | | | | | | |
| Winter rape | | | | | | | |
| Peas | | | | | | | |
| Potatoes | | | | | | | |
| Sugarbeets ** | | | | | | | |
| Total plants silage (cereals) | | | | | | | |
| Rape on set aside | | | | | | | |
| Oil linseed | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| end 20 | | | | | | | |

* e.g. Crop Insurance, Silo Plastic, irrigation (water, fuel and lubricants)

## 2.4 Mineral balance and fertilizer input

2.4

Insert fertilizer costs or only the input in kg mineral (purchased) fertilizer or a combination of both f.ex. N=180 kg/ha , 300 EUR/ha costs of P,K,Ca

| | | A | B | C | D | E |
|---|---|---|---|---|---|---|
| | | Nitrogen | Phosphorus | Potash | Calcium | Other |
| | | kg / ha | kg / ha | kg / ha | kg / ha | kg / ha |
| Set aside | | | | | | |
| Pastureland | | | | | | |
| Grass silage | | | | | | |
| Hay | | | | | | |
| Grass on arable land | | | | | | |
| Maize silage | | | | | | |
| Winter wheat | | | | | | |
| Winter barley | | | | | | |
| Rye | | | | | | |
| Triticale | | | | | | |
| Straw | | | | | | |
| Winter rape | | | | | | |
| Peas | | | | | | |
| Potatoes | | | | | | |
| Sugarbeets ** | | | | | | |
| Total plants silage (cereals) | | | | | | |
| Rape on set aside | | | | | | |
| Oil linseed | | | | | | |
| 0 | | | | | | |
| 0 | | | | | | |
| end 20 | | | | | | |

| **Fertilizer input prices** | **Example** | Nitrogen | Phosphorus | Potash | Calcium | Other |
|---|---|---|---|---|---|---|
| Type of fertilizer used | CAN | | | | | |
| % mineral nutrient | 0.27 | | | | | |
| Price in C/t | 1 | | | | | |

## 2.5 Prices for feed and dry matter content

**for all enterprises!**

2.5

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| | C / t | Dry matter (%) | MJ | % | txt | 1-0 |
| Concentrates | | | | | | |
| Minerals | | | | | | |
| Milk replacer | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| end 20 | | | | | | |

## 7 Data for the Ewe Enterprise

7.1 - 7.7 | 7.1 to line 1902

### 7.1 Inventory and Performance data

| Livestock Inventory | | |
|---|---|---|
| No. of Ewes | No. heads | |
| No. of Breeding Rams | No. heads | |

| Output and Herd Management | | Flock 1 | Flock 2 | |
|---|---|---|---|---|
| Ewe breed | text | | | |
| Ram breed | text | | | |
| % ewes per flock | 0,0x | | | 1) |
| Lambs born alive per ewe and year | 0,0x | | | 2) |
| Lambs marked per ewe and year | 0,0x | | | 2) |
| Average lambing day | days | | | 3) |
| Age at first lambing | months | | | 4) |
| Age at weaning female lambs | days | | | |
| Age at weaning male lambs | days | | | |
| Post-weaning time female lambs | days | | | 5) |
| Post-weaning time male lambs | days | | | 5) |
| Weight at birth female lambs | kg LW | | | |
| Weight at birth male lambs | kg LW | | | |
| Share of artificial insemination | 0,0x | | | |
| Share of male lambs castrated | 0,0x | | | |

7.1 from line 1904

| Livestock sales | | Flock 1 | Flock 2 |
|---|---|---|---|
| Cull breeding ram | No. heads | | |
| Breeding ram sold for breeding | No. heads | | |
| Ewes culled | 0,0x | | |
| Ewes going to finishing | 0,0x | | |
| Ewes sold for breeding | 0,0x | | |
| Young ewes (x-12) culled | 0,0x | | |
| Young ewes (x-12) sold for breeding | 0,0x | | |
| Young ewes (x-12) to finishing | 0,0x | | |
| Young ewes (12-18) culled | 0,0x | | |
| Young ewes (12-18) sold for breeding | 0,0x | | |
| Young ewes (12-18) to finishing | 0,0x | | |
| Young ewes (>18) culled | 0,0x | | |
| Young ewes (>18) sold for breeding | 0,0x | | |
| Young ewes (>18) to finishing | 0,0x | | |
| Female lambs/transferred sold as stores | 0,0x | | |
| Male lambs sold/transferred as stores | 0,0x | | |
| Female lambs sold for slaughter at weaning | 0,0x | | |
| Male lambs sold for slaughter at weaning | 0,0x | | |
| Female lambs sold for slaughter later | 0,0x | | |
| Male lambs sold for slaughter later | 0,0x | | |
| Female lambs sold for breeding | 0,0x | | |
| Male lambs sold for breeding | 0,0x | | |

| Sale weights | | Flock 1 | Flock 2 |
|---|---|---|---|
| Cull ewes | kg LW | | |
| Cull breeding ram | kg LW | | |
| Cull young ewes (x-12 months) | kg LW | | |
| Cull young ewes (12-18 months) | kg LW | | |
| Cull young ewes (>18 months) | kg LW | | |
| Weight of female store lambs | kg LW | | |
| Weight of male store lambs | kg LW | | |
| Weight of female slaughter lambs at weaning | kg LW | | |
| Weight of male slaughter lambs at weaning | kg LW | | |
| Weight of female slaughter lambs sold later | kg LW | | |
| Weight of male slaughter lambs sold later | kg LW | | |

| Dressing percentages lambs | | | |
|---|---|---|---|
| Dressing percentage females at weaning | 0,0x | | |
| Dressing percentage males at weaning | 0,0x | | |
| Dressing percentage females later | 0,0x | | |
| Dressing percentage males later | 0,0x | | |

| Livestock Losses | | Flock 1 | Flock 2 |
|---|---|---|---|
| Ewes | 0,0x | | |
| Breeding rams | 0,0x | | |
| Young ewes (x-12) | 0,0x | | |
| Young ewes (12-18) | 0,0x | | |
| Young ewes (>18) | 0,0x | | |
| Female lambs | 0,0x | | |
| Male lambs | 0,0x | | |

### 7.2 Prices and direct payments received in the Ewe Enterprise

7.2

| Meat Price | Live weight prices! | Flock 1 | Flock 2 |
|---|---|---|---|
| Cull breeding ram | c / Kg | | |
| Cull ewes | c / Kg | | |
| Cull young ewes (x-12 months) | c / Kg | | |
| Cull young ewes (12-18 months) | c / Kg | | |
| Cull young ewes (>18 months) | c / Kg | | |
| Female lambs sold for slaughter at weaning | c / Kg | | |
| Male lambs sold for slaughter at weaning | c / Kg | | |
| Female lambs sold for slaughter later | c / Kg | | |
| Male lambs sold for slaughter later | c / Kg | | |

| Livestock and Breeding Prices | Per head prices | Flock 1 | Flock 2 |
|---|---|---|---|
| Buy/sell breeding ram | c / head | | |
| Young ewes (x-12) for breeding | c / head | | |
| Young ewes (x-12) to finishing | c / head | | |
| Young ewes (12-18) for breeding | c / head | | |
| Young ewes (12-18) to finishing | c / head | | |
| Young ewes / ewes (>18) for breeding | c / head | | |
| Young ewes (>18) to finishing | c / head | | |
| Young ewes / ewes (>18) purchased for breedi | c / head | | |
| Female lambs to finishing / sold as stores | c / head | | |
| Male lambs to finishing / sold as stores | c / head | | |
| Female lambs sold for breeding | c / head | | |
| Male lambs sold for breeding | c / head | | |

| Ewe payments | | |
|---|---|---|
| Ewe and goat premium | c / head | |
| Supplementary payment | c / head | |

## 7.3 Wool and skin

7.3 - 7.4

| Wool yields | | Flock 1 | Flock 2 |
|---|---|---|---|
| Breeding rams | kg LW | | |
| Ewes | kg LW | | |
| Young ewes (x-12) | kg LW | | |
| Young ewes (12-18) | kg LW | | |
| Young ewes (>18) | kg LW | | |
| Female lambs | kg LW | | |
| Male lambs | kg LW | | |
| **Wool quality** | | | |
| Breeding rams | micron | | |
| Ewes | micron | | |
| Young ewes (x-12) | micron | | |
| Young ewes (12-18) | micron | | |
| Young ewes (>18) | micron | | |
| Female lambs | micron | | |
| Male lambs | micron | | |
| **Wool prices** | | | |
| Breeding rams | c / Kg | | |
| Ewes | c / Kg | | |
| Young ewes (x-12) | c / Kg | | |
| Young ewes (12-18) | c / Kg | | |
| Young ewes (>18) | c / Kg | | |
| Female lambs | c / Kg | | |
| Male lambs | c / Kg | | |
| **Skin weights** | | | |
| Breeding rams | kg | | |
| Ewes | kg | | |
| Young ewes (x-12) | kg | | |
| Young ewes (12-18) | kg | | |
| Young ewes (>18) | kg | | |
| Female lambs | kg | | |
| Male lambs | kg | | |
| **Skin prices** | | | |
| Breeding rams | c / kg | | |
| Ewes | c / kg | | |
| Young ewes (x-12) | c / kg | | |
| Young ewes (12-18) | c / kg | | |
| Young ewes (>18) | c / kg | | |
| Female lambs | c / kg | | |
| Male lambs | c / kg | | |

## 7.5 Variable Costs of the Ewe Enterprise

7.5

**Note: As many costs as possible should be entered here. Only costs that can not be assigned to the ewe-lamb or other enterprise should enter into fixed cost of the farm.**

| Variable Costs per ewe | | Flock 1 | Flock 2 |
|---|---|---|---|
| Veterinary service | c / head | | |
| Medical products | c / head | | |
| Maintenance and spare parts | c / head | | |
| Bedding | c / head | | |
| Water | c / head | | |
| Electricity | c / head | | |
| Gas, oil | c / head | | |
| Transport | c / head | | |
| Sales commission | c / head | | |
| Expenses for growth hormones | c / head | | |
| Scanning (preg test) | c / head | | |
| Fees for Desease Prevention Board | c / head | | |
| Fees for Pedigree Records | c / head | | |
| Advisory Services Ewe | c / head | | |
| Insurance Ewe | c / head | | |
| Transport papers | c / head | | |
| Predator control | c / head | | |
| Other / Miscellaneous | c / head | | |
| **Variable Costs per kg LW** | | | |
| Transport / Hauling | c / Kg | | |
| Promotions | c / Kg | | |
| 0 | c / Kg | | |
| 0 | c / Kg | | |
| **Specific wool cost per head** | | | |
| Shearing | c / head | | |
| Sorting + baling | c / head | | |
| Storing | c / head | | |
| Transport | c / head | | |
| Other / Miscellaneous | c / head | | |

## 7.6 Rations for Ewes and Lambs

7.6

| Homegrown feed | Ewes flock 1 | Ewes flock 2 | | Lambs flock 1 | Lambs flock 2 |
|---|---|---|---|---|---|
| | t per animal and year | | | t per animal and year | |
| Set aside | | | | | |
| Pastureland | | | | | |
| Grass silage | | | | | |
| Hay | | | | | |
| Grass on arable land | | | | | |
| Maize silage | | | | | |
| Winter wheat | | | | | |
| Winter barley | | | | | |
| Rye | | | | | |
| Triticale | | | | | |
| Straw | | | | | |
| Winter rape | | | | | |
| Peas | | | | | |
| Potatoes | | | | | |
| Sugarbeets ** | | | | | |
| Total plants silage (cereals) | | | | | |
| Rape on set aside | | | | | |
| Oil linseed | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| end 20 | | | | | |

| Purchased Feed | t per animal and year | | | t per animal and year | |
|---|---|---|---|---|---|
| Concentrates | | | | | |
| Minerals | | | | | |
| Milk replacer | | | | | |
| 0 | | | | | |
| Saltrock | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| 0 | | | | | |
| end 20 | | | | | |

## 7.7 Rations for young sheep

7.7

| Homegrown feed | Young ewes x-12 flock 1 | Young ewes 12-18 flock 1 | Young ewes >18 flock 1 | | Young ewes x-12 flock 2 | Young ewes 12-18 flock 2 | Young ewes >18 flock 2 |
|---|---|---|---|---|---|---|---|
| | t per animal and year | | | | t per animal and year | | |
| Set aside | | | | | | | |
| Pastureland | | | | | | | |
| Grass silage | | | | | | | |
| Hay | | | | | | | |
| Grass on arable land | | | | | | | |
| Maize silage | | | | | | | |
| Winter wheat | | | | | | | |
| Winter barley | | | | | | | |
| Rye | | | | | | | |
| Triticale | | | | | | | |
| Straw | | | | | | | |
| Winter rape | | | | | | | |
| Peas | | | | | | | |
| Potatoes | | | | | | | |
| Sugarbeets ** | | | | | | | |
| Total plants silage (cereals) | | | | | | | |
| Rape on set aside | | | | | | | |
| Oil linseed | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| end 20 | | | | | | | |

| Purchased Feed | t per animal and year | | | | t per animal and year | | |
|---|---|---|---|---|---|---|---|
| Concentrates | | | | | | | |
| Minerals | | | | | | | |
| Milk replacer | | | | | | | |
| 0 | | | | | | | |
| Saltrock | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
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| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| 0 | | | | | | | |
| end 20 | | | | | | | |