Elsenburg Joernaal
Journal

A Framework for the Development of New Crops Industries in South Africa

J.G. Theron
Western Cape Department of Agriculture, Farmer Support and Development, Stellenbosch

Introduction

The grain industry (mainly maize and wheat) is the largest crop industry in South Africa under rain-fed conditions. Significant changes have taken place since deregulation in agriculture and the termination of subsidies from mid 1990s. The total area under grain has decreased by about 10% to 15% (C. Du Plessis, pers. commun. 2001) due to lower prices (based on import parity and free market forces) and the higher risk of production because of the absence of state subsidies. Consequently, grain planting has decreased significantly on low potential land as well as on high potential land in remote areas.

In future, global market forces will test the viability of all agricultural commodities being produced in South Africa. Agriculture is still an important part of the national economy and greatly influences rural economy. Diversification or substitution by new crops could provide opportunities to improve the viability of the agricultural sector *per se*. This would be the case where the production of commodities or other established industries, have become non-competitive. However, the development of most new industries or businesses is usually complicated because of the high risks involved. It is therefore necessary to develop guidelines, frameworks, and processes to improve the success rate of new agricultural industries.

There are examples of successful new crop industries established in South Africa. One is the canola industry in the Western Cape Province. It has grown from virtual no industry since early 1990s, to a production area of 30,000 ha currently, with two processing plants in place (B.F. Saaiman, pers. commun. 2001). This development is significant in a South African context.

The roots of this industry started with a contract Canadian researcher. His instruction was research on alternative crops for the wheat industry in the Western Cape Province. Canola proved to be the best alternative of crops tested. It was first considered for a domestic niche market. Farmers started to produce in small quantities and the crop was pressed at an existing oilseed company. The production of canola increased to such an extent that this plant could not handle the supply. Consequently, two plants were erected by agricultural co-operatives. This was not done simultaneously, but only after the capital investment was justified by regional levels of canola production. At present research is being carried out on uneven germination that poses a barrier to the growth of the industry (A.J. van W. Conradie, pers. commun. 2001).

Factors in new Agriculture Industries

Janick (1999) classified food crops on the basis of their economic importance. **Major crops** are cultivated worldwide in adapted areas with high economic value and are associated with high genetic input. They include grains, forages, oilseeds and grain legumes, tuber crops, fruits, vegetables, and sugar crops. **Speciality crops** are niche crops that, while economically important, have small markets that can be filled by a relatively few growers. Included are a number of horticultural species including fruit, vegetable, and spice crops. **Under-utilised crops** were once more widely grown but are now falling into disuse for various agronomic, genetic, economic, or cultural factors. In general, they are characterized by much less genetic improvement than the major crops but they are being lost because they are less competitive. Examples include cereals such as emmer and spelt; pseudocereals such as buckwheat; and oilseeds such as sesame and safflower. **Neglected crops**, traditionally grown in their centers of origin and where they are important for the subsistence of local communities, are maintained by socio-cultural preferences and traditional uses. These crops remain inadequately characterised and, until recently, have been largely ignored by agricultural researchers and genetic conservation. Yet they may represent our most valuable potential resource for the future. In some cases, their lack of exploitation is an historical accident. Examples include the Andean root and tuber crops, and the minor millets such as *Panicum, Paspalum*, and *Digitaria* species. **New crops** include those recently developed from wild species whose virtues are newly discovered, formerly collected of wild-crafted species, or synthesized crops created from interspecific or intergeneric crosses. They represent only a handful of cultivated species and very few are included as new foods. Totally new crops from wild species are mainly associated with industrial crops such as *Limnanthes alba* (meadow foam), a source of unique seed oils, or *Taxus brevifolia*, a source of Taxol®, a valuable anticarcinogen. **Genetically transformed crops** include those modified by recombinant DNA technology. Gene splicing is now an established technique with over 50 transgenic crops field-tested in the United States. Rates of adoption by farmers for transgenic cotton, soybean, and maize have been very high from the first releases in 1996.

When new crop industries are promoted it is important to make use of acquired experience, knowledge, and wisdom. There are many pitfalls to avoid and numerous risk factors to be managed. McKinna (1999) has identified critical success factors in new agricultural industries (Table 1). The two most critical factors on the list are capital availability and an effective market development plan.

Pasqual (1995), stressed the importance of a market driven approach to new crop selection. She further stated that the identification of crop opportunities with good prospects relies on ascertaining their demand by overseas consumers. A database has been developed and the following limits were placed in order to avoid duplication: (1) each product is unique in the database—there is only one entry for each type of product; (2) price information is limited to retail prices, (3) availability of a product in a certain country may not necessarily mean it is in demand, (4) fresh product information is limited to the season covered by the market survey; and (5) food products in demand by the food service sector and exotic or medicinal food preparations are not covered.

It is clear that development of new crop industries is basically the creation of new business opportunities. Risk is one factor that needs special attention in this regard. The reason for this is that new crop industries are usually considered higher risk enterprises than conventional crop farming. Future trading (market), financial (economic), physical (production) and social (personal and management) environments are more likely to be unknown and thus it is more difficult to generate the profit outcomes sought (Buffier 1998).

Krause (1996), recommended the following steps when new crop business opportunities are evaluated: (1) do a risk audit or develop a risk profile; (2) develop a business plan with goals, objectives, budgets and cash flows; (3) use financial modeling of cash flows to examine the impact of different events occurring; (4) calculate the profitability using appropriate measures such as npv (net present value) and irr (internal rate of return); (5) look at the risk/reward ratio relative to the level of risk that is acceptable; and (6) understand the "fall-back" position if the venture fails.

Industries or companies based on raw materials from agriculture differ distinctly from other business in one particular aspect; it is depended on agricultural production. Selection of new crops is not an easy task because a whole range of factors has to be considered. A checklist for the selection of new crops has been published in the Australian New Crops Newsletter (1998). The shortened list of criteria only as far as crops directly are concerned is: botanical/geographical, agronomic, production, production economics, domestic production, and funding of domestic research.

Proposed structural framework for the development of new crop industries

A simplified, holistic outline of the main elements for the development of new crops industries is proposed in Fig. 1. It is an attempt to provide an organisational framework for use in different situations. Thus an individual intending to take advantage of a niche market, or a company wanting to implement vertical integration, could make use of these basic principles, which are essentially the same for all market entrants. The different segments of the value chain in Fig. 1 indicate domestic or foreign contributions to the total chain. For example, if a product for a sophisticated market is produced, it might be expected that only the agricultural part of the value chain would be done locally. There are therefore possibilities for strategic alliances and partnerships depending on specific situations. Where resources are limited, as is the case in South Africa, co-operation at all levels with local and foreign partners is crucial. Successful implementation requires attention to establishment of goals (Table 2) for each element in the value chain.

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Table 1. *Critical success factors in new agricultural industries.*

Factor	Most important elements
An effective industry association	Effective chief executive with good supporting staff. Expertise in finance, legal, marketing, business management, technical production, agropolitics and government relations. Full support from the industry with adequate representation Adequate finance and financial mechanisms and structures
Adequate funding for the commercial stage	New industries must have sufficient capital to finance infrastructure, systems and research and development. Capital is required up front with the prospect of not being repaid for more or less five years.
An efficient production capability	The new industry must be profitable in the light of what is usually formidable global competition and hence must strive for world's best practice in production. Farms must be able to maintain their commercial viability as farm gate prices decline. Genetic material are at an early stage of evolution with growth, yields, and quality often low to that of the traditional industries.
An efficient processing and value-added capability	Establishing appropriate technology and production systems usually by adapting technologies from other industries. Skills development of the labor force. Achieving economic output levels of the value adding plant.
A market driven product specification and quality assurance regime	The key quality/performance specifications for a new product need to be determined, along with quality assurance procedures that the quality and performance of the product and its suitability for predict various end users. Hence, standards must be developed. Quality compliance might become too difficult for some producers. Selling outside the system results in the undermining of prices and return.
An effective trading/distribution mechanism	The economy of distribution is heavily driven by volume. A strategic alliance is recommended with organizations which distribute complementary but not non-competitive products to same customer base
An effective market development program	With new products the market is very thin; it only takes 5 to 10 tonnes of oversupply to flood the market and cause prices to free fall. Lack of funding. Market development activity, particularly promotion, is quite expensive and usually requires activity both locally and overseas. Product availability. Market development activities need to occur to create demand before the product becomes available for consumers to buy. Such activities can be restricted by a lack of product, including the problem of not having samples for prospective customers.
A brand oriented marketing and promotional strategy	Branding is a proven marketing tool. If done well, branding will generate brand loyalty and premium returns and will give an industry a greater degree of control over the market channel. Branding is more than labeling a product. It needs to be underpinned by a strong marketing strategy and culture, committed to quality.

Factor	Most important elements
The ability to dispose of all products at economically viable levels	Product markets usually have no difficulty in disposing of the top quality product at a high return. All industries inevitably produce a certain percentage of lower quality/less preferred product, regardless of their commitment to quality and this product must be disposed of satisfactorily.
Managing the transition from speculative (the stage where pioneers foresee a huge commercial potential and start to interest others, who may be driven by an interest in capital gains and tax deductions) to commercial stage.	There is a role for government in regulating the speculative stage. At the very least, it should tighten up the requirement for prospectuses on new enterprises. There is a need to ensure that potential investors or participants are well informed about what they are getting into, for instance the long-term prospects and critical success factors.
An adequate funded and well run R&D function	New industries need research and development on several fronts: on farm production; product description and quality; processing and value adding; product performance; transportation and distribution; and market research and intelligence. One of the key roles of the industry association is to identify R&D priorities and to ensure that the funding and expertise are in place.
Effective dealing with bioethical issues	New agricultural industries are likely to face novel bioethical issues which the industry associations must be ready to deal with effectively as they arise.

Table 2. *Implementation of new crops: goals to achieve.*

Element	Requirement
World market	• Competent strategic management • Market driven approach where consumer needs are most important • Knowledge of possible markets • Availability of detailed market information • Market information continuously updated and stored
Agriculture	• Crop selection basis (potential adaptability, productivity, and target market), complexity of production, availability of effective pesticides and herbicides, harvesting process and technology available, information and research backup, state of economy in present agricultural industry, capital requirements, compatibility with present agricultural activities and technology in use, risks involved, environmental implications, social acceptability) • Cost effective transportation of raw materials is in place • New crops promoted only after development of a business plan • Efficient growers association in place
Processing industry	• Matching processing plant development (capital requirement) and agricultural production (volumes) • Adaptation of existing technology to reduce initial cost • Risk management in place • Effective co-operation and communication • Cost effective and economical production • Products continuously produced according to the minimum standards required by the market • Standards are in place, strictly according to market preference • New products can be developed
Retailers and other service providers	• Services needed to sell products are in place; outlets, promotion, market development, and distribution
Other important aspects	• Competent strategic management is conducted (business development) • Efficient services for every part of the value chain exist • Research & development for every part of the value chain is in place

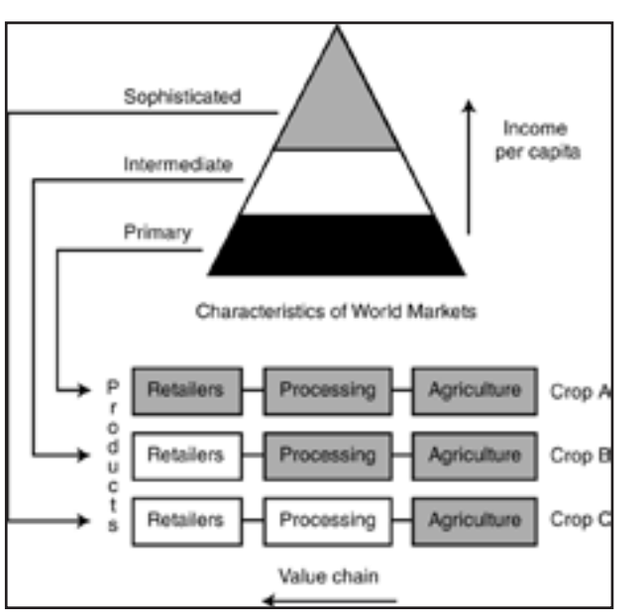

Fig. 1. *Elements of new crop development. Shaded boxes indicate local activity (adapted from Alvaro Altuve 2001).*

Farm Workers, Job Security and Labour Contractors

Elné Jacobs
Western Cape Department of Agriculture, Agricultural Economics

Abstract
Labour contractors' involvement in the Agricultural sector has increased recently due to a variety of reasons. There is the technological change that makes production more expensive and the legal ambiguities that present opportunities for labour contractors. Labour contractors provide cheaper, seasonal employment to farmers, taking the legislative responsibility away from the farmer. But the Standard Employment Act of South Africa does not cover this three-tiered relationship between farmer, labour contractor and farm worker, causing widespread concern over the use of unregulated labour contractors. Labour Force Survey results suggest a move away from permanent workers within the Western Cape Agricultural sector towards more seasonal employment and casualisation and one case study suggests the unfair treatment of farm workers employed by unregulated labour contractors. This paper investigates the available information on employment trends and labour contractor involvement, and the effect it has on farm workers.

Introduction
The South African labour market, and especially the agricultural sector, has been characterized by a recent trend towards seasonal employment and casualisation is a consequence of this movement. Labour Force Surveys indicate the decrease in permanent larbour within the sector, suggesting a move towards more seasonal employees. Van der Burg (2008:6) holds the flexibility and openness of the sector responsible for this occurrence. Globalisation, technological innovation and import and export increases have created a trend towards temporary employment offered by labour contractors. Conradie (2006:1) argues that falling farm profits and rising cost of production has caused farm owners to move away from permanent farm workers, using labour contractors to minimize cost and responsibility, and to increase production. Another reason given by Conradie (2006: 7) for this move towards casualisation is that of the passing of the Extension of Security of Tenure Act (Act 62 of 1997). This Act provides that households who live on farms may not be unlawfully evicted and the conditions of unlawful evictions are stated. But farmers perceived this law as giving farm workers permanent rights to their land (Conradie 2006:9). Employers thus tried to distance themselves from permanent workers and started using labour contractor services for casual and seasonal employees.

Regardless of the cause, an opening in the market emerged, and labour contractors stepped forward. Labour contractors provide farmers temporary employment, taking the legislative responsibility away from farmers. For the farmer it's a winning situation: He does not have to employ permanent workers and thus pay wages all year round due to legal duty and he gets employment in times of need. But farm workers are being marginalised in the process. There is no job security and no provision is made in the legal framework of the Standard Employment Act of South Africa. The most vulnerable are thus more vulnerable.

The Western Cape Agricultural sector has been no exception to the rule, and labour contractors are increasingly visible throughout the province. Conradie (2006:1) states that the seasonal employment (especially on fruit and wine farms) is widespread in the Western Cape, and although Conradie does not report on labour contractor activity, it implies that labour contractors have more than enough opportunity for business prospects. Barrientos and Kritzinger (2004) claims that in a global economy, outsourcing is the norm, especially in export agriculture.

It can be argued that a mixture of environmental factors, such as globalization and technology, and legal loopholes presented opportunities for farmers and farm workers to separate, giving rise to labour contractors. The next section presents the results form the Labour Force Surveys from 2000 till 2007 to prove the incline in seasonal workers. Labour contractors will then be defined together with notes on the potential impact it has on farmers and farm workers. Case Studies will be referred to throughout the discussion. The last section investigates the legal gaps presented by the South African Employment Act in order for better understanding to make recommendations. Conclusions and recommendations are made from the provided information.

Evidence of Labour Force Surveys
Every year since 2000, in March and September, Statistics South Africa conducted the Labour Force Survey in order to gain information from the labour force regarding demographic indicators. One of the questions that was asked of respondents (only the employed) was that of the terms of employment. Respondents had to classify whether their work were permanent, a fixed period, temporary, casual or seasonal (Statistics South Africa). Full time workers according to Statistics South Africa, are employees that work an agreed number of hours (normally more than 40 hours a week) in a particular occupation, whereas part-time employees work less than 40 hours a week. Permanent workers are those who have a job with no set termination date, while a fixed period worker have a contract for more than a year but with a set termination date. Temporary workers, as defined by Statistics South Africa, are workers that are appointed on a short-term contract basis, normally shorter than a year, and excluding the self-employed. Casual workers are workers that do not fall within the permanent or temporary classification and works on an hourly or daily basis. Also, they are not entitled to employee benefits such as medical aid or Unemployment Insurance (Statistics South Africa). Seasonal workers are not distinctly defined differently from casual workers, but Statistics South Africa does record both seasonal and casual workers for analysis purposes. This creates uncertainty of measurement within these two categories.

The following figure represents the findings for this question regarding the Western Cape Agricultural workers:

Only the March survey of every year was taken into account. There is clearly an increase and then a reduction in permanent employment, while the fixed period employment remains fairly stable. A case study done by Conradie (2006) reveals that more than 50% of farmers in the Hex River Valley have cut their permanent workforce since 1998 and 40% more reveals that they planned to cut even further. Temporary employment decreased slightly whereas casual employees increased since

2003. Seasonal employment increased considerably (from 26 000 to 39 000 workers) which might indicate that workers moved from permanent and temporary employment towards seasonal employment. This is more visible in the 2006 and 2007 data, where permanent and seasonal employment is mirror images of each other. Investigating the employment figures with regards to race, the following pattern occurs:

Above figure indicates that employment within the agricultural sector decreased steadily since 2000, but this was due to mainly Coloured workers leaving the sector. Quantec (Consultancy) total employment data were compared to Labour Force data, and a similar trend is recognized. Taking into consideration both figures, seasonal employment increased in spite of overall decreases in employment. There is thus evidence that some of the permanent worker decrease is accounted for by the seasonal worker increase, but the overall decrease suggests that more workers leave the agricultural sector than workers joining it. The increase in seasonal workers might be explained by workers without any other means of income, and therefore accepting the terms of the seasonal employment standards. One thing is for sure: Seasonal workers increased and permanent workers decreased, creating the current opportunities for labour contractor involvement.

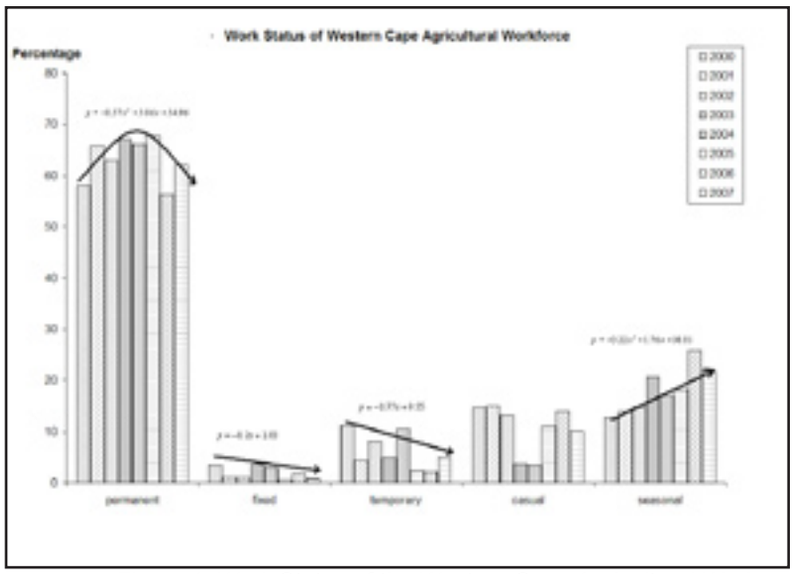

Figure 1: Work Status of the Western Cape Agricultural Workforce from 2000 till 2007 Source: Own Calculations out of Labour Force Survey's 2000-2007

Labour Contractors

According to Wikipedia (online), a contractor is an agent, "one that acts on behalf of a principal". In Agriculture, a labour contractor is the mediator between farmer and farm worker. The farmer does not want to employ permanent workers, for various reasons, and uses contractors to provide them with workers if need be. Contractors in turn employ workers to work on farms where they as contractors get work contracts. This seems like an ideal situation, farmers benefit from attaining workers to fulfil their requirements, and farm workers can live where they want to, and work on different farms. Farm workers therefore can get all the amenities of living in the urban areas, but still work on farms.

But labour contractors are unregulated in most of South Africa, and not covered in the legal framework[1]. Due to this unregulated design, data for labour contractors and labour contractor involvement is limited. Two case studies were done from 2006 to investigate the casualisation of workers and labour contractor's participation in the process. The first study was conducted by Conradie in 2006 at the Hex River Valley grape farms. Casualisation, as part as employment trends, were analysed and results included that the reallocation of permanent workers to seasonal workers in other fruit farms were not visible in the case study. There was a steady decline in employment, but this was due to technological change and not legislative changes relating to land and labour. The composition of the workforce also did not change dramatically. Concluding from the case study is that legalisation is not always the cause of casualisation, but it may contribute towards the process. The Extension of Security of Tenure Act (Act 62 of 1997) is an example of such contribution from legislation. More reliable data is also needed for measuring casualisation. Data collection needs to be sensitive to the irregular work conditions of off-farm seasonal workers in order to record consistent employment patterns. The question of the employment strategy from the farmer remains puzzling and it seems that it depends on the farmer's perception of the economic state of affairs and authoritarian environment.

The second case study was conducted by the Centre for Legal Rural Studies and Women on Farms Project in the Grabouw area between November 2007 and February 2008. Findings concluded that seasonal workers and permanent workers do not receive the same benefits; only permanent workers are likely to receive benefits; transportation and accommodation of seasonal workers are troublesome; there is no clarity of who the employer is, some say the farmer, others say the contractor; seasonal workers are not registered for Unemployment Insurance or Workmen's compensation or belong to a union; and some element of child labour was detected. Workers were paid under the minimum wage and only work certain days, the principle of no work no pay applies. They are also paid by performance, which mean the physically stronger or more efficient worker get paid more, making it difficult for women to ensure a better income. Migrant workers dominate (64% were from Transkei) because the contracts offered by the building sector provides better pay to local workers. 75% of labour contractors also do not have any knowledge of the labour law of South Africa and they work from their homes. Their conclusions from the case study is that casualisation gives rise to the employment figures of seasonal and migrant workers which in turn creates an unstable and unfair labour market where the legal framework of South Africa have no reach.

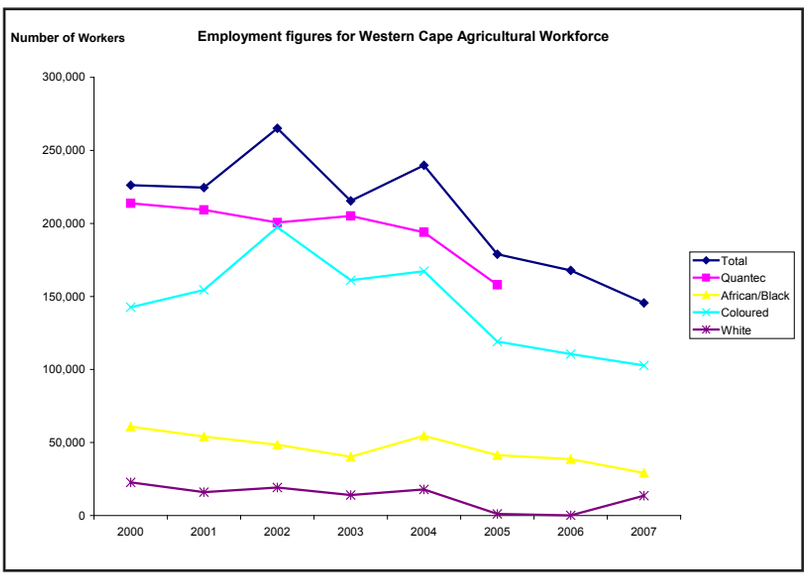

Figure 2: Employment data for Western Cape Agricultural Workforce from 2000 till 2007 Source: Own Calculation from Labour Force Survey's 2000-2007 and Quantec Data (2008)

These two case studies indicate that casualisation is on the rise, and labour contractors are using the opportunity presented to them. Because of the unregulated environment, farm workers

1 See next section for detailed discussion

might experience unfair treatment.

Legislative ambiguities

The South African legal framework is based on the standard employment relationship where employment is fulltime, a designated workplace is assigned and an employee contract exists. This two-tier affiliation does not include a third party like a labour contractor (Theron J. 2007:4). This employee contract does provide for temporary workers, but temporary workers usually are employed on the basis of filling in for another worker on maternity leave or during a busy season. Temporary Contract of Employment is a contract between the agency and employer and no relationship exist between the worker and employer (Basic Conditions of Employment Act of 1997, Department of Labour). Again only a two-tier relationship exists. Casual workers are defined within the legislation as anyone who works within the informal sector or a formal sector employee with a temporary, seasonal or casual contract. The key word contained by the formal sector is that of a contract.

The casual worker is therefore not fully covered by the standard employment relationship due to its definition (Van der Burg A. 2008:17). Firstly casual workers do not have fulltime employment and their workplace does not cater for labour contractor involvement. The workplace differs as the labour contractor moves from farm to farm. Due to the two-tier relationship, a contract only exists between employer and employee, which begs the question: In the farm worker – labour contractor – farmer connection, who is the employer and who is the employee? Usually there will only exist a contract between the farmer and labour contractor, leaving the farm worker exposed. Therefore casual workers do not qualify for standard employee benefits such as social security and bonuses (Van der Burg A. 2008:13). The current legal framework also does not cater for labour contractor registration and regulation, leaving the labour contractors to do as they wish.

These legislative gaps provide a background for non-equitable practices within the Agricultural sector; open for exploitation by anyone who wants to avoid the legislative lags that are associated with official procedures.

Conclusion

Labour right's violations in the Agriculture sector in South Africa is on the rise due to the use of unregulated labour contractors (Van der Burg 2008:2). Casualisation of farm workers cause a three-tier relationship with the farm worker, labour contractor and farmer as key players, but this relationship is not covered within the legal framework. Only a two-tier relationship is covered, and usually the farmer and labour contractor abide to the legal regulations, leaving the farm worker legally exposed. Farm workers, without written contracts, hence have no standard employee advantages. The most vulnerable are thus pushed further into defencelessness, causing widespread concern over the use of unregulated labour contractors. Legislation such as the of Security of Tenure Act (Act 62 of 1997) also caused farmers to reduce their permanent workforce, creating farm workers without written contracts and job security. But it is not only the legal gaps that caused this occurrence, but the ever-changing environment of the global economy. Rising technological advances and import-export requirements cause lower prices and higher factor cost. The labour contractor provides farmers with a cheaper option of employment without legal formalities.

A case study done in the Western Cape Province indicated that labour contractors are worsening the fate of seasonal workers, however another indicate that legal obscurities are not always to blame for casualisation. Data from Statistics South Africa's Labour Force Surveys indicate that there was indeed a significant increase in seasonal employment, indicating that the overall trend suggest a move away from permanent employment. Whether this is because of labour contractors or technological advances, more exploration into the subject is needed to make accurate conclusions.

Nevertheless, there is evidence that labour contractors' involvement is greater than ever, but this brings the next question to mind: How to improve the position farm workers are currently facing? Labour legislation can change, but operational factors are more difficult. Recommendations from these findings include the revision of the South African labour law to ensure the three-tier relationship is covered within the legal framework, making sure realistic ways of enforcing legislation are found, and labour contractors must be regulated to ensure registration of workers for benefits received by permanent workers such as the Unemployment Insurance Fund. With the increased use of labour contractors, better transport facilities for the workers and women rights need to be scrutinised to ensure a fair labour market. There is also a need for thorough research into possible models which might help the fate of the most vulnerable in in the agricultural sector.

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Die benutting van laekoste oesreste vir die produksie van superfynwol onder ingekraalde toestande in die Wes-Kaap

B B Aucamp & T S Brand
Western Cape Department of Agriculture, Institute for Animal Production, Western Cape

Die belangrikste kwaliteitseienskap in die verwerkingsproses van wol is die gemiddelde veseldikte en daarom het dit ook die grootste invloed in die prysbepaling van wol (Rae, 1982). Naas die aanvanklike invloed wat genotipe op wolgroei het, is voeding die omgewingsfaktor wat die grootste invloed het op die groei van wolvesels, veral wat veseldikte betref (Reis, 1982). Dit is bekend dat beperkte of lae kwaliteit voeding ’n vermindering in veseldikte tot gevolg het. Dit behoort dus moontlik te wees om veseldikte te manupileer onder gekontroleerde voedingstoestande. Die kwaliteit en dus die prys wat wol behaal word ook negatief beïnvloed deur besoedeling met stof en plantmateriaal. Sonlig dra ook by tot die verwering van wolvesels (Reis, 1982).

In die lig van die groot prys premie wat superfynwol behaal is ’n proef uitgevoer om te bepaal of veseldikte verminder kan word deur rantsoene wat hoofsaaklik uit laekoste oesreste bestaan aan genetiese fynwol Merino skape te voorsien (groot hoeveelhede lae kwaliteit oesreste is in die Wes-Kaap beskikbaar). Om die persentasie skoonopbrengs van die wol te verhoog is die proef onder ingekraalde toestande uitgevoer. Die ideaal is ook om die diere in goeie kondisie te hou. Indien ’n verlaging in veseldikte moontlik is, het die proef ook verder ten doel gehad om die ekonomiese regverdigbaarheid van die praktyk te ondersoek, aangesien die rantsoene ’n vermindering in wolproduksie tot gevolg mag hê.

Materiaal en metode

Vyftig twee jaar oue fynwol Merino ooie afkomstig van die Grootfontein Merino stoet in die Oos-Kaap is ewekansig volgens liggaamsmassa in vyf groepe van tien elk verdeel. Die skape is elkeen afsonderlik in ’n hokkie op hortjiesvloere in ’n goed geventileerde gebou geplaas. ’n Midrib wolmonster vir veseldikte (VD) ontleding is van elke skaap geneem. ’n Rantsoen bestaande uit 50% lusernhooi en 50% koringstrooi is *ad. lib*. vir ’n aanpassings periode van een maand voorsien. Die vyf groepe het daarna die verskillende rantsoene soos in Tabel 1 daagliks *ad. lib*. ontvang. Na ’n maand is die ooie geskeer om enige wolbreuke wat as gevolg van aanpassing op die lae kwaliteit rantsoen kon ontstaan te verwyder. Onmiddelik na skeer is ’n jas vir elke skaap aangesit. Liggaamsmassas is maandeliks bepaal en midrib wolmonsters is na ses maande en weer na 12 maande wolgroei geneem waarna die skape geskeer is en vagmassas bepaal is (onderlyne buite rekening). Die rantsoene is chemies ontleed vir totale as, ruproteïen soos beskryf deur die AOAC (1985) en suurbestandevesel en neutraalbestande vesel is beraam volgens die metodes van Van Soest (1963) en Van Soest en Wine (1967). Die *in vitro* verteerbare organiese materiaalinhoud is bereken volgens die metode van Tilley en Terry (1963).

Die data van veseldiktes en liggaamsmassa is met behulp van analise van variansie statisties ontleed met behulp van ko-variante. Veseldiktes en liggaamsmassas met aanvang van proef was onderskeidelik die ko-variante.

Veseldikte is deurmiddel van die OFDA metode deur die Woltoetsburo van S.A. bepaal.

Resultate

Die chemiese ontleding van die vyf rantsoene word in Tabel 2 vertoon.

In Tabel 3 word die produksie data van die vyf groepe skape vertoon. Die aanvanklike gemiddelde veseldikte van al die skape was 19,16μ. Die gemiddelde veseldikte van monsters van al vyf groepe was laer (15,4μ) na die 12 maande proefperiode. Die gemiddelde veseldikte na ses maande was 15,9μ. Die grootste verskil in veseldikte van die aanvang tot 12 maande wolgroei het in groep vyf (4,72μ) voorgekom. Die gemiddelde veseldikte van groep vyf (14,4μ) was betekenisvol laer as die van die in groepe een, twee en drie terwyl die van groepe een en twee betekenisvol hoër was as die van groepe vier en vyf. Groep twee het die kleinste verlaging in veseldikte (3,06μ) gehad.

Die gemiddelde skoonwol opbrengs was 81,1% vir al die skape. Die gemiddelde skoonwolmassa van groepe een en twee was betekenisvol hoër as die van groepe drie, vier en vyf met groepe vier en vyf ook betekenisvol laer as groep drie.

Die gemiddelde aanvanklike liggaamsmassa van al die skape was 39.2kg. Die endmassas van groep een en twee was hoër as die beginmassas terwyl groepe drie, vier en vyf se endmassas laer was as die beginmassas met groep vyf wat die grootste daling het.

Groep een het ’n betekenisvolle hoë vrywillig rantsoen inname gehad as groep drie, vier en vyf.

Gevolgtrekking

Die lae kwaliteit dieet het wel ’n verlaging van die aanvanklike veseldiktes tot gevolg gehad. Die skape wat rantsoen vyf met die hoogste strooi inhoud en geen graan ontvang het, het die grootste verlaging in veseldikte en liggaamsmassa gehad asook die laagste gemiddelde wolmassa.

Die chemiese ontleding van die rantsoen monsters toon geen noemenswaardige verskille in ruproteïen, vesel of organiese materiaal verteerbaarheid nie. Die diëte het egter verskil in terme van kwaliteit van proteïene sowel as vlak van die graankomponent wat ’n defnitiewe rol in voerkwaliteit sal speel.

In Tabel 4 word slegs beraamde pryse vir veseldiktes van 13 mikron tot 17 mikron gegee,aangesien wol met hierdie lae veseldiktes nie algemeen bemark word nie (Scott, 2001).

Die gemiddelde opbrengs (R) van die ooie in die vyf groepe se wol word in Tabel 5 gegee. Uit die Tabel kan afgelei word dat, indien die vagte volgens veseldikte verpak en bemark sou word, groep een die hoogste inkomste sou lewer. Die laer vagmassas van skape in bv. groep vyf benadeel die prys voordeel wat deur die laer mikrons behaal kon word.

Verwysings

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Tabel 1: Rantsoen samesellings wat ad. lib. aan vyf groepe voorsien is.

Bestandeel	% Samestelling				
	Groep 1	Groep 2	Groep 3	Groep 4	Groep 5
Gemaalde koring strooi	74.40	79.20	84.00	88.90	93.70
Gars	20.00	15.00	10.00	5.00	0
Melasse meel	2.00	2.00	2.00	2.00	2.00
Ureum	1.40	1.50	1.60	1.70	1.80
Vitamien & mineraal premix	0.20	0.20	0.20	0.20	0.20
Dikalsiumfosfaat	1.20	1.27	1.35	1.42	1.50
Sout	1.00	1.00	1.00	1.00	1.00

Tabel 2: Chemiese samestelling van rantsoene (100% DM)

Meting	Groep 1	Groep 2	Groep 3	Groep 4	Groep 5
Ruproteïen	10.80	10.77	9.57	9.29	10.72
Ruvesel	35.25	36.35	35.95	32.86	33.79
OMV	47.84	44.20	48.73	54.22	49.83
SBV	43.73	43.80	43.14	38.95	39.60
NBV	64.28	67.82	65.41	65.53	65.93
Ca	1.00	0.83	0.80	0.68	0.67
P	0.23	0.27	0.28	0.32	0.36

Tabel 3: Die produksie data van die vyf groepe skape

Meting	Groep 1	Groep 2	Groep 3	Groep 4	Groep 5
Aanvanklike Veseldikte	19.02	19.27	19.06	18.53	19.83
VD* na 6 maande	16.3a	16.6ab	16.23ab	15.5bc	15.0c
VD na 12 maande	15.9c	16.1a	15.6ab	15.0bc	14.4c
VD verskil	3.29a	3.06a	3.52ab	4.20bc	4.72c
End massa	41.4a	40.1a	35.9b	34.6bc	33.8c
Begin massa	39.8	38.3	40.2	37.5	39.5
Massa verskil	2.2a	0.9a	-3.3b	-4.6bc	-5.4c
Ruwol massa	2.95a	3.11a	2.32b	1.85c	1.64c
Skoonwol massa	2.39a	2.52a	1.88b	1.50c	1.33c
Daaglikse inname	1.07a	0.92ab	0.86b	0.82b	0.80b

*Veseldikte

Tabel 4: Beraamde pryse van 17 mikron wol en fyner (Scott, 2008)

Veseldikte (µ)	Beraamde prys/kg skoonwol (R)
13.0	500.00
13.5	475.00
14.0	450.00
14.5	395.00
15.0	380.00
15.5	270.00
16.0	180.00
16.5	160.00
17.0	145.00

Tabel 5: Gemiddelde opbrengs (R) van vyf groepe se wol (elke vag volgens veseldikte verpak)

Groep	Opbrengs (R)
1	586.6
2	528.1
3	524.6
4	552.6
5	431.9

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The carry-over effect of supplementation in the previous year on the production of South African Mutton Merino ewes

L. Brundyn[1,2], T.S. Brand[1,#], A.V.Ferreira[2], B.B. Aucamp[1] & A. Durand[3]
Western Cape Department of Agriculture, University of Stellenbosch, Langgewens

Abstract
A trial was conducted to determine the carry-over effect of supplementation in a previous year on the production of South African Mutton Merino ewes (SAMM) in the following year while grazing cereal stubble. Three hundred and sixteen ewes were divided into four flocks, of which two grazed oat stubble, and two grazed wheat stubble. Each of these four flocks was again subdivided into four groups, of which two subdivisions received supplementation, and two received none. Four subdivisions received 200 g/d from the 6 March 1998 until the 28 May 1998, while the other four subdivisions received 200 g/d from the 5 March 1999 until the 18 April 1999. This was increased to 300 g/d from 19 April 1999 until the 25 May 1999. The ewes were weighed on a monthly basis. Due to supplementation in 1998, birth status (lambs born per ewes mated) showed a tendency ($P = 0.07$) to increase in 1999, while weaning status (lambs weaned per ewes mated) was not significantly ($P = 0.43$) affected by supplementation in the previous year. Both birthweight and weaning weight of lambs were negatively ($P \leq 0.05$) affected by supplementation in the previous year, possibly due to the tendency for the higher birth rate achieved. The initial live weight of the ewes as well as kilogram weaned lamb/ewe was unaffected by supplementary feeding in the previous year.

Introduction
The Swartland area of the winter rainfall region of South Africa is predominantly a wheat-sheep farming area with the available forage during summer and autumn being dominated by cereal stubble.

The stubble constitute a major part of the diet of pregnant and lactating ewes during the summer and early autumn months, and due to low digestibility (Purser, 1983) and protein (Coombe, 1981), supplementation has to be provided in most cases to prevent weight loss of ewes (Weston & Hogan, 1986; Aitchison, 1988; Brand *et al*., 1992a). Inadequate provision of nutrients also cause an inadequate milk supply in ewes as well as poor pre-weaning growth in lambs. The low productivity of animals grazing cereal stubble is also associated with a low digestibility (Dann & Coombe, 1987), which results in a reduced intake (Mulholland *et al*., 1976) of the available material. Inadequate nutrient content may be aggravated by the reduced intake capacity of the late pregnant ewe (Weston & Hogan, 1986).

The main objective of supplementing the diets of ruminants, which are grazing low-quality pastures, like cereal stubble, is to correct ruminal or animal deficiencies in the diet (Dann & Coombe, 1987). However, in may cases producers did not provide supplementary feed to ewes due to economical considerations. The direct advantages of supplementary feeding to cereal stubble is described well, while the carry-over effect of the provision of supplementation to stubble lands in the previous year on the production of ewes in the following year is a field where little research has been documented. Nutrition of the female from the foetal stage until she reaches maturity, may influence the reproductive performance by affecting firstly the time or age of onset of the first estrus, secondly by affecting the fertility and fecundity at this first estrus, or lastly by residual effects on reproductive performance during the remainder of the reproductive life (Gunn, 1983).

This study was conducted to determine the influence of supplementation in the previous (1998) year on the productive performance of SAMM ewes and lambs in the following year (1999), while grazing wheat stubble lands during both years.

Materials and Methods
An experiment was conducted at the research farm, Langgewens, which is situated in the Swartland area of the winter rainfall region of South Africa. The area has a Mediterranean climate and receives 78% of the annual precipitation during the winter (33°17′S, 18°42′E, altitude 177m). Three hundred and sixteen South African Mutton Merino (SAMM) ewes were divided into four flocks (Table 1). The project was done over a two-year period. In 1998 two flocks of sheep grazing respectively oats and wheat residues were divided into four groups each. The first group grazed a 20 ha oat stubble camp at a stocking density of 5.0 ewes/ha and the second group grazed an 11.8 ha wheat stubble camp at a stocking density of 4.7 ewes/ha. Every group was subdivided into four groups of which two subdivisions received supplementation and two received none. The two groups received supplementation from the 6 March 1998 until the 28 May 1998 at a rate of 200 g/d. In 1999 two flocks of sheep similarly grazing respectively oats and wheat residues were divided into four groups each. The first group grazed a 21 ha wheat stubble camp at a stocking density of 4.8 ewes/ha, and the second group grazed a 14 ha oat stubble camp at a stocking density of 4.3 ewes/ha. Each group was subdivided into four groups again of which two subdivisions received supplementation and two received none. These groups received supplementation from the 5 March 1999 until the 18 April 1999 at a rate of 200 g/d, after which it was increased to 300 g/d from 19 April until 25 May (Table 1). Supplementation was given during the last four weeks of pregnancy until the first eight weeks of lactation in the form of a lick (Table 2). During both years the four groups of sheep within each flock were rotated between the four camps to eliminate any possible camp effects.

The effect of the feeding treatment in the previous year (1998) on production in the following (1999) year was detected by Least significant difference (LSD) and analysed according to a two (supplementary feed or none in the previous year) by two (supplementary feeding or none in the current year) factorial design. The LSD test was only used when a significant F-value in the analysis of variance table was observed (Snedecor & Cochran, 1980). Ewe and lamb data were corrected for multiple births by linear model procedures where applicable.

Results and Discussion
The effect of dietary treatment in both the previous year (1998) and the following year (1999) on production parameters obtained were assessed and are presented in Table 3. The data revealed no significant interactions between years and the dietary effect of each year was presented separately. It is evident that the number of lambs born showed a tendency to improve with supplementation provided in 1998 ($P = 0.07$), but the number of lambs weaned per ewes mated was not significantly affected ($P = 0.43$) by the supplementation provided in 1998.

Table 1: Details of experiments performed with SAMM ewes grazing cereal stubble

Experiment no.:	1	2	3	4
Year	**1998**	**1998**	**1999**	**1999**
Type of stubble	Oat	Wheat	Wheat	Oat
Paddock size (ha)	20	11.8	21	14
Number of ewes	100	56	100	60
Stocking density	4	4	4	4
Stubble grazing	5.0	4.7	4.8	4.3
Starting date	30 Dec.	30 Dec.	22 Jan.	22 Jan.
End date	28 May	28 May	25 May	25 May
Number of days	150	150	124	124
Supplementation				
Starting date	6 March	6 March	5 March	5 March
End date	28 May	28 May	25 May	25 May
Number of days	83	83	81	81
Amount (g/ewe/day)	200 g/d+	200 g/d+	200 g/d++ 300 g/d	200 g/d++ 300 g/d
Total supplementation (kg/ewe)	16.6	16.6	19.9	19.9
Lambing date	12 Apr.	12 Apr.	12 Apr.	12 Apr.
Weaning date	10 Sep.	10 Sep.	25 Aug.	25 Aug.

+ 200 g/d from 6 March 1998 until 28 May 1998
++ 200 g/d from 5 March 1999 until 18 April 1999
300 g/d from 19 April 1999 until 25 May 1999

Table 2: The physical and chemical composition of the supplementary liick supplied to producing SA Mutton Merino ewes while grazing grain stubble during the dry summer period

Item	Content (%)
Physical composition (air dry)	
Barley meal	57.00
Cottonseed oil-cake meal	22.10
Urea	3.70
Feed lime	1.55
Molasses meal	1.50
Sulphur	0.15
Salt	14.00
Chemical composition (dry matter)	
Dry matter	85.5
Crude protein	17.4
Crude fibre	6.7
Ether extract	2.2
Ash	4.8
Total digestible nutrients	63.7
Metabolizable energy (MJ/kg)	8.0
Calcium	0.6
Phosphorus	0.4
Magnesium	0.3
Sulphur	0.3

The birthweight ($P = 0.003$) as well as weaning weight ($P = 0.005$) of the lambs whose mothers received supplementation in 1998 was lower than those that did not receive supplementation. This was probably due to the increase ($P \leq 0.07$) in the number of twin lambs in the ewes that received supplementation the previous year. The initial bodyweight ($P = 0.23$) as well as the kilogram weaned lamb/ewe ($P = 0.81$) was unaffected by supplementation in the previous year.

The number of lambs born per ewes mated ($P = 0.89$) as well as the number of lambs weaned per ewes mated ($P = 0.64$) was also not affected significantly by the treatment provided in 1999. The initial bodyweight of the ewes ($P = 0.05$) that received supplementation was significantly higher than those that did not receive supplementation, due to the fact that the supplemented ewes had to rear multiple lambs. The kilogram weaned lamb/ewe ($P = 0.63$), as well as the birthweight ($P = 0.16$) and weaning weight ($P = 0.29$) of the lambs was higher in the lambs whose mothers received supplementation in 1999, although it was not significantly affected.

The treatment in terms of supplying adequate nutrition through pasture to the ewes in the rest of their reproduction cycle (e.g. the dry period) will have an undoubted influence on the carry-over effect of supplementation on the reproductive performance of the ewe. If there is adequate pasture with a high quality, a possible carry-over effect on the production of the ewes may probably be neutralized. In a study conducted by Gibb & Baker (1988), where the performance of young steers receiving stack-treated ammoniated hay or untreated hay, were evaluated with and without supplementation, it was concluded that over the summer period at pasture, the mean daily live weight gains showed no carry-over effects of winter treatment and the final live weights still reflected the effects of treatment the previous winter ($P < 0.05$). In the steers that received untreated hay there was an indication of compensatory growth, although the differences were not significant.

Hughes *et al*. (1978) studied the long-term effect of a winter supplement on (supplied at low, moderate, high and very high levels) the productivity of range cows for ten consecutive winters. In the first four calf crops, high levels of supplement resulted in earlier ($P < 0.025$) calving dates. Increasing supplement from the low to high levels resulted in larger birthweights in calf crops from year one ($P < 0.001$), two ($P < 0.025$), three ($P < 0.025$) and nine ($P < 0.025$). There was a decline in the calving percentages of calf crops from year two and three, but all treatment groups had similar values in calf crop from year four and succeeding calf crops. In the present study, the birthweight of the lambs from unsupplemented ewes were higher than those of the supplemented ewes during treatment in 1998 due to an increase in the twinning rate of the supplemented ewes. Supplementation in 1999 however, produced heavier lambs than the unsupplemented ewes. Although the very high level cows had a high calving percentage (0.93) in calf crop one, Hughes *et al*. (1978) found that the weaning percentage for this group was only 0.66, which was significantly less than the low (0.82) and high (0.82) level groups. The low weaning percentage for the very high group was due to the fact that about 33% of the calves were stillborn, due to dystocia in the obese heifers. Even though the low level group had the same weaning percentage value as the high level group, kilograms of calf weaned per cow exposed were considerably lower, probably due to the differences in milk production of the dams. The low and moderate levels of supplementation during the first winter were apparently sufficient to support adequate conception in the first breeding season. These lower levels of supplementation, coupled with the stress of pregnancy and lactation, appeared to be inadequate to support normal estrus and reproduction. In the present study, the kilogram weaned lamb/ewe in 1999 was not affected significantly by treatment in both years (1998 and 1999), although it was higher in the supplemented ewes in 1999.

Baker & Gibb (1995) studied the performance of Friesian steer calves when reared over winter on a silage (S) or on a

silage plus concentrate (SC) diet. It was found that the dietary treatment during the winter had no significant carry-over effect on performance during the grass-feeding period and there was no indication of compensatory growth by the steers that received silage alone. Short *et al*. (1996) conducted a four-year experiment to determine the effects of protein supplementation, age at weaning and calf sire breed on cow and calf performance during fall grazing. Some carry-over effects of treatments were observed the next spring in cow weight, condition score, and birthweight ($P < 0.01$), but there were no effects by the next fall on weaning weight or pregnancy rates.

The lack of response in the live weight of ewes in the present study could be accounted for by the fact that mature ewes were used. In a study by Allden (1979), an unrestricted level of feeding for the first eight weeks of life prior to a lengthy period of restriction was very effective in establishing a high reproductive potential, compared to restricted nutrition from birth. This emphasises the importance of nutrition early in life. This was also indicated by Reardon & Lambourne (1966), who indicated that there may be a critical development period which is very sensitive to nutrition and which will greatly affect the genetic potential achieved by the ewes later in their life.

Conclusion

In conclusion, it is evident that supplying supplementary feed in the previous year did not have a significant carry-over effect on production in the following year. Although there was a tendency for ewes to produce more lambs when receiving supplementation the previous year, the number of lambs weaned did not improve significantly, rendering it economically unjustifiable to provide supplementation in order to obtain a significant carry-over effect. A probable carry-over effect on the production of the ewes will also be smaller if adequate pasture is supplied in the dry period. The animals used in the study were mature, while young growing animals may probably be more exposed to a possible carry-over effect.

Table 3 :The effect of supplementation in both the previous (1998) and present (1999) year on production of SA Mutton Merino ewes in the following year (mean ± SE)

Production (1999)	Treatment in 1998		SEM	P
	No supplementation	Supplementation		
Ewes:				
Initial bodyweight,kg	68.86	70.54	1.01	0.23
Weaning lamb weight/ ewe+++	28.79	30.00	1.37	0.81
Lambs:				
Birthweight,kg	4.94[a]	4.42[b]	0.12	0.003
Weaning weight,kg	27.95[a]	25.00[b]	0.75	0.005
Birth status+	1.09	1.37	0.10	0.07
Weaning status++	0.94	1.05	0.10	0.43
Production (1999)	**Treatment in 1999**		**SEM**	**P**
	No supplementation	Supplementation		
Ewes:				
Initial bodyweight,kg	71.03	68.36	0.98	0.05
Weaning lamb weight/ ewe+++	26.71	32.42	1.37	0.63
Lambs:				
Birthweight,kg	4.56	4.80	0.12	0.16
Weaning weight,kg	25.93	27.02	0.76	0.29
Birth status+	1.22	1.24	0.10	0.89
Weaning status++	0.96	1.02	0.09	0.64

+ Lambs born/ewes mated
++ Lambs weaned/ewes mated
+++ Weaning weight of lambs x weaning status
Values in rows not followed by the same superscript differ ($P < 0.05$).

Acknowledgements
The Elsenburg Agricultural Research Centre for providing funds for the experiment. The Technology and Human Resources for Industry Program (THRIP) for financial contributions to the project.

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