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Proceedings of the 4<sup>th</sup> Biennial Conference  
of the  
African Farm Management Association

# **Farm and Farmer Organisation for Sustainable Agriculture in Africa**



Edited by  
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26 - 30 January 1998  
University of Stellenbosch, South Africa

# ASPECTS OF SUSTAINABLE DAIRY FARMING IN THE SWARTLAND

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## ABSTRACT

*Dairy farming in the Swartland, one of the regions in the Western Cape Province where milk is produced, was until the last decade a very important source of cash flow in farming, in contrast with wheat and sheep farming which produces an annual income.*

*Presently the average size of a dairy is approximately 300 to 450 cows in production. In exceptional cases, there are even larger herds of 900 to 1000 cows in production. Feeds such as silage and grain are self produced but cows are fed in a feedlot. Dry cows and heifers, however, graze on winter grasses such as oats and on stubble lands during summer. The long, dry and hot periods during summer go hand in hand with the Swartland and do not allow dairy farming on permanent grazing.*

*An economical case study was done on feedlot dairying. The results showed that nearly one third of the dairies operate at a loss, while a third run on a low profit. The profit in the top third was satisfactory.*

*Results indicate that there is a need for research to determine whether it is possible to find methods to:*

- *improve the effectiveness of the dairy industry*
- *co-ordinate with a crop rotation in order to produce more feed*
- *incorporate dairy farming in a supplementary relationship in the farming system to improve profits.*

*The first step will be to identify the limiting factors i.e. management, feeding, sheltering, etc to optimise production efficiency and to expose it to the other overhead limiting factors to put the sustainability to the test, that is, overall farm planning.*

*Dairy farming is a long-term activity and therefore the research in sustainability should at least correspond with the rotation of the annual crops to incorporate the dairy. An optimising technique which can be implemented in this regard is Dynamic Linear Programming (DLP).*

## 1. Introduction

Dairy farmers in the Swartland who produce fresh milk on zero grazing, also known as the feedlot system, are in a financial crisis and presently fighting for survival. Sustainable solutions can make the industry competitive.

One of several possibilities being investigated to increase productivity is the application of a high standard of herd management and the production of feed as a complementary activity on a mixed grain farm. Louw (1996:2) describes how the Dynamic Linear Programming (DLP)-

computer programme simultaneously optimises the allocation of thousands of limited sources to alternative activities.

The feedlot system in the Swartland is highly geared for maximum production. Farm size has little influence on the size of the dairy, since feedstuff is bought in. In the South Coast region on the contrary, dairy animals are run mainly on dryland grazing. The size of the dairy is scaled down to the capacity that the farm can carry. Dairy is generally practised as a complementary farming branch where production takes place at minimum feeding costs and concentrates are fed as a supplement to the pastures. The average size of the herd in the Swartland is 101 cows in milk as against 37 cows in the South Coast region. In the Swartland, herds of 400 cows in milk are common, while herds of 1000 cows in production are the exception.

The Swartland is predominantly a wheat-growing area, where fresh milk is produced and delivered to the Cape Metropolitan area. The Swartland is a relatively small area of the Cape Province, but produces more milk than the other regions in the province. In the other regions, viz. the Boland and South Coast, milk is mainly processed into cheese, yoghurts and butter.

## 2 The agro-ecological regions of the Western Cape Province

The agro-ecological regions in the province are Boland, Karoo, Northwest, South Coast, Swartland, the Northwest and the Karoo. Milk is mainly produced in the Swartland, Boland and South Coast region. In the Karoo region milk is mainly produced in the Ladismith, Calitzdorp and Oudtshoorn areas. Figure 1 shows where the regions are situated in the Western Cape Province.

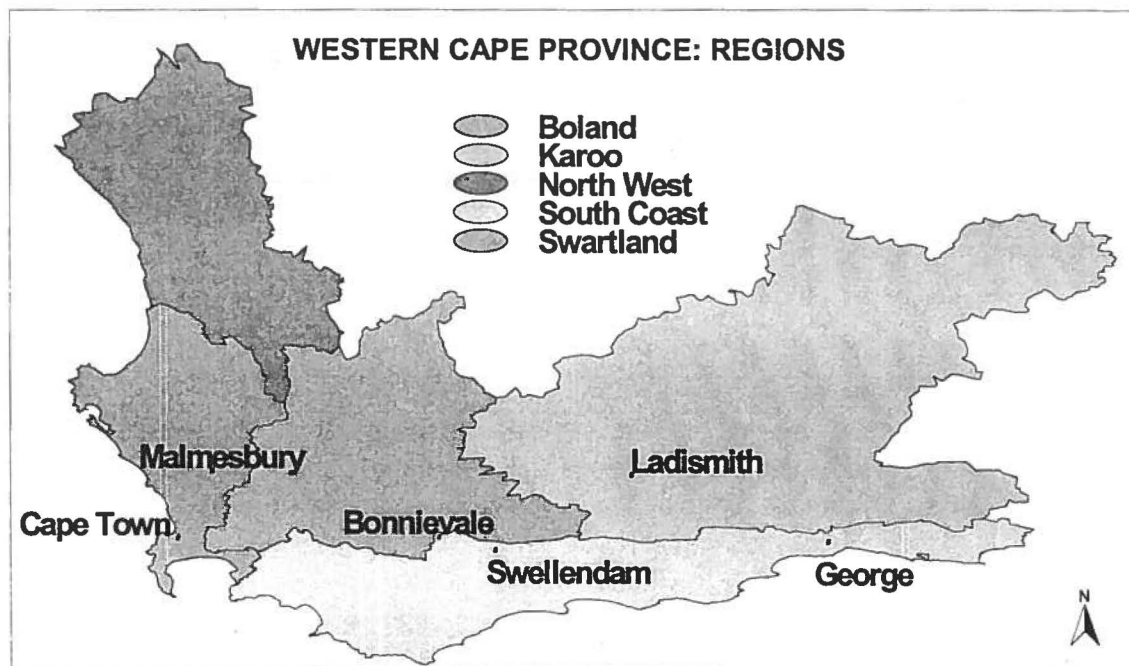


Figure 1. The regions in the Western Cape Province

Source: Division Resource Utilisation (1997), Dept. of Agriculture: Western Cape, Elsenburg

### 3. Rainfall

#### 3.1 The Swartland

The rainfall pattern determines the dairy system. The average rainfall is measured over long periods in every region. In the Swartland the rainfall pattern leads to the implementation of the feedlot system due to the long and dry summer periods.

Due to the low rainfall in the later months of the growing season, September and October are determining months for the production of wheat and pastures. Practically, the wet season is from May to August. Figure 2 shows the typical rainfall pattern with an average of 454-mm pattern monitored at five weather stations over the Swartland region.

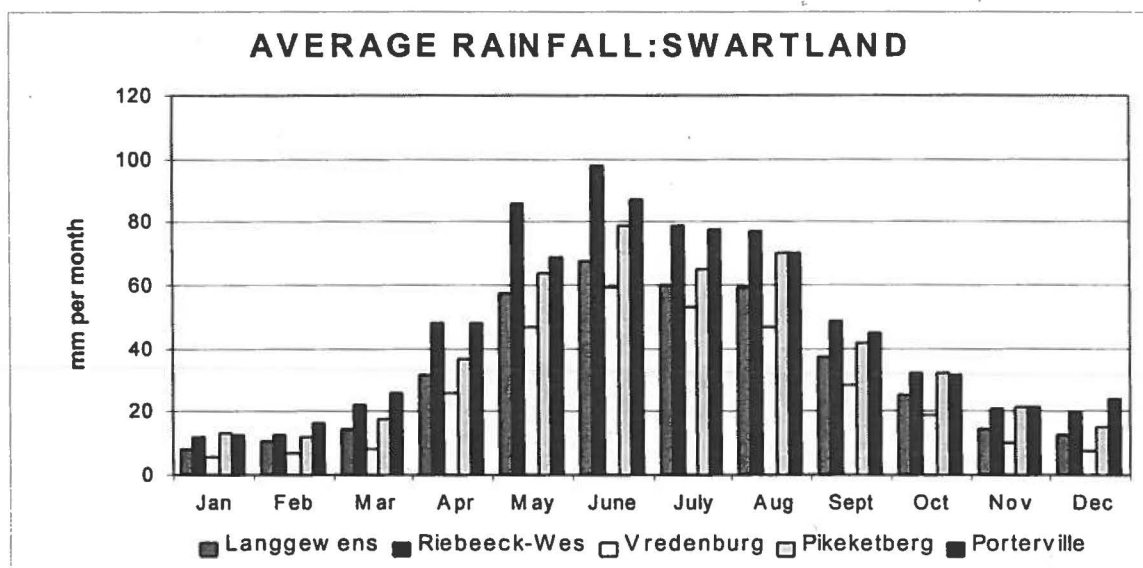


Figure 2. Average rainfall in the Swartland

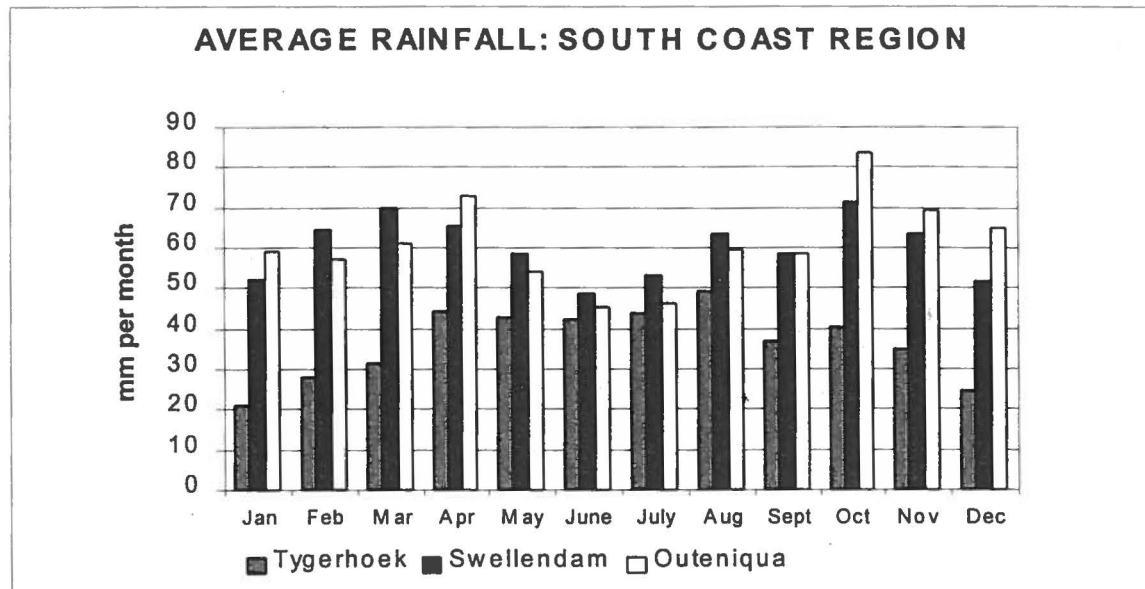
Source: Institute for Soil, Climate and Water (1997)

The long dry period from September to April eliminates the possibility of dairy farming off dryland pastures. Farmers normally produce silage for cattle in rotation with wheat, which is the main farming enterprise in the Swartland. The running of dual-purpose sheep is also common practice, since this is part of the crop rotation system with medic and clover pastures.

#### 3.2 The South Coast region

The rainfall distribution over the South Coast region is monitored at the Tygerhoek, Swellendam and Outeniqua weather stations. The average rainfall is 630 mm and peaks during the summer months. This makes the region suitable for pastures. For higher production, some farmers do combine the feedlot and grazing systems.

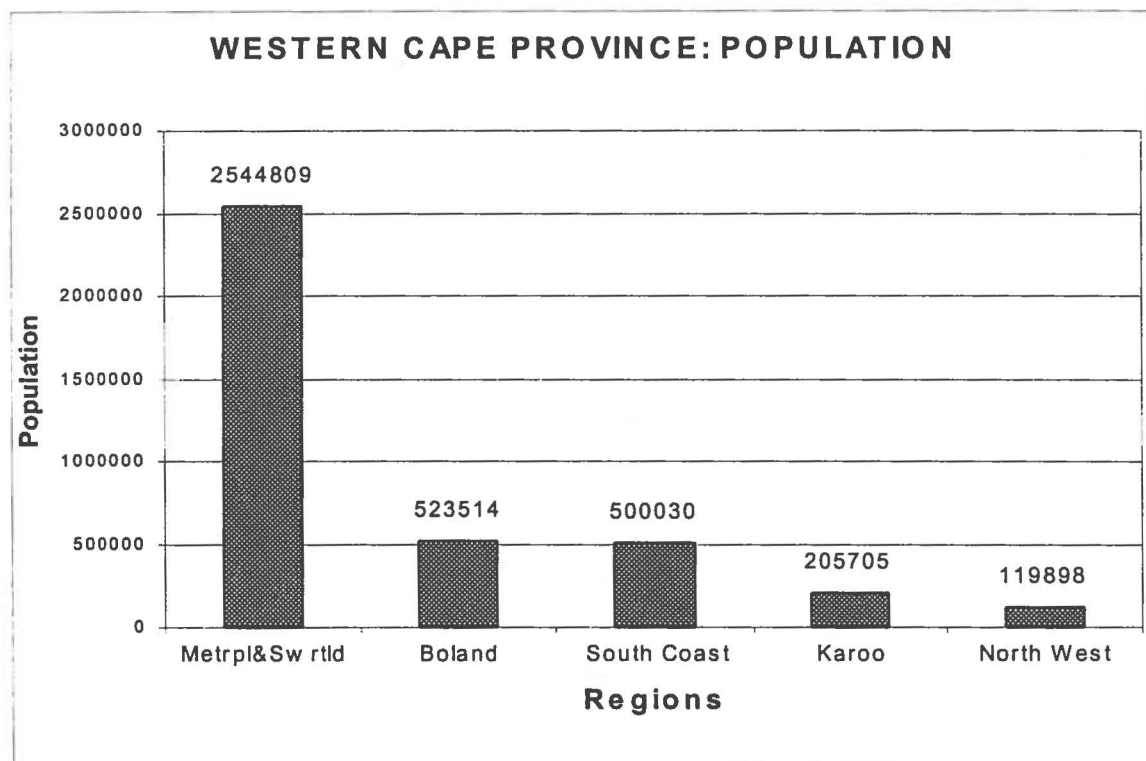
The rainfall pattern in figure 3 reveals a reverse situation of Figure 2. Figure 3 shows the rainfall taken over a long period at three weather stations in the South Coast region.



**Figure 3.** Average rainfall in the South Coast Region  
Source: Institute for Soil, Climate and Water (1997)

#### 4. Population in the Western Cape Province and milk production

The largest concentration of people in the Western Cape Province occurs in the Swartland region with the Cape Metropole representing by far the highest population density. The largest market for fresh milk is therefore in the Cape Metropolis. The population distribution in the Western Cape Province is demonstrated in Figure 4.



**Figure 4.** Population distribution in the Western Cape Province  
Source: Zietsman (1997)

The population in the South Coast region is small and spread out, compared with the Swartland and Boland. Consequently, the fresh milk market is small in that region. The population in the Northwest region is smallest and most decentralised.

#### 4.1 *Milk producers in the Western Cape Province*

The producers in the Swartland and southern Boland are situated near Cape Town and are spread over an area reaching as far as Strand, Wellington, Vredenburg and Darling.

Dairies in the South Coast region are also widely spread, but over a much larger area. The milk is sent to processing plants for dairy products such as cheese, yoghurts and butter. Factories are situated at, for instance, Ladismith in the southern part of the Karoo, Mossel Bay on the South Coast and at Bonnievale in the eastern part of the Boland. Figure 5 demonstrates the distribution of milk producers in the Western Cape.

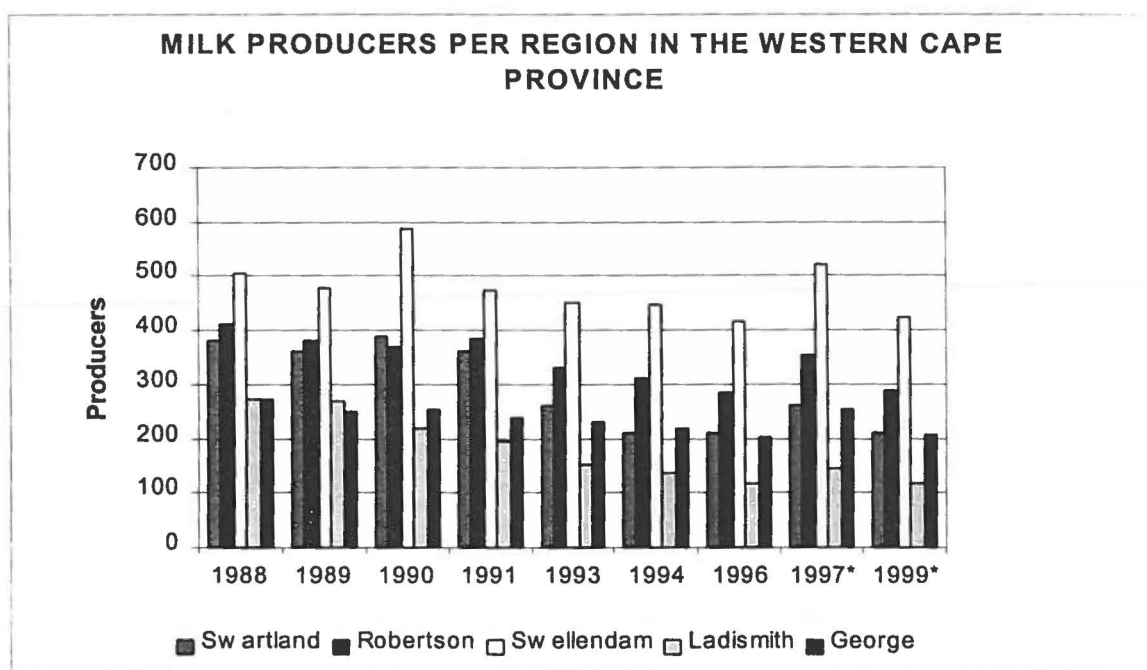


Figure 5. *Distribution of milk producers in the West Cape Province*  
Source: Dept. of Agriculture: Western Cape (1996)

In the South Coast region (bordering on eastern Boland and the southern Karoo) there was 1020 producers as against 209 in the Swartland in 1996. In 1990, comparative numbers were 1427 as against 388. Producers in the Swartland decreased by 43.6 percent compared to 32.9 percent in the South Coast region.

#### 4.2 *The production of milk in the Western Cape Province*

There is no limit to the scope for milk production in a feedlot system. The management capability of the farmer, however, may constitute a limiting factor. Milk production per region is demonstrated in Figure 6. Producers in the Swartland who produce exclusively in feedlots exceed the milk volume of other regions by far. In 1990 the total production of the other regions was 221 million litres against 174 million litres in the Swartland.

## MILK PRODUCTION PER REGION IN THE WESTERN CAPE PROVINCE

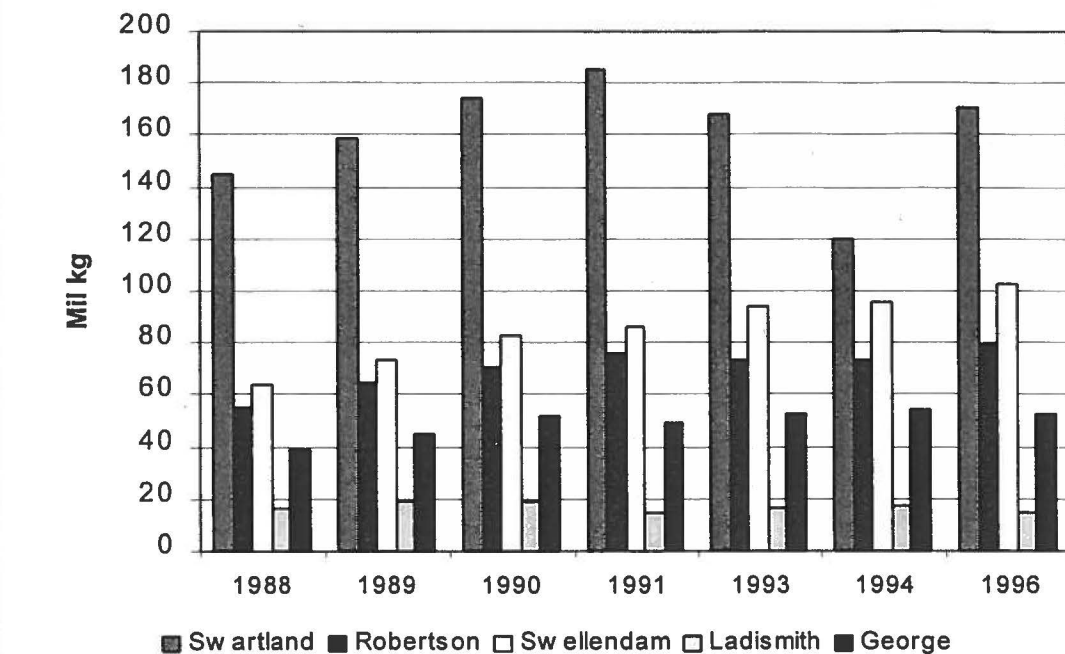


Figure 6. The production of milk in the Western Cape Province

Source: Dept of Agriculture: Western Cape

In 1996 the comparative figures were 242 million as against 171 million. The change in production over the same period was +8.7 per cent for the other regions as against -2.9 percent for the Swartland. For practical reasons the production volume remained constant, while the number of producers decreased drastically. There was a significant increase in the producer price but this only occurred towards the end of 1996.

### 5. Economic indicators

Until about 1986, producers enjoyed protection via a Milk Board, which had statutory powers included among others, that:

- it was the sole buyer,
- it fixed the milk price which was based on production costs,
- it determined how much milk should be produced, according to a quota system, and
- if there was an overproduction, it disposed of it by, for instance, buying the milk at a lower price and processing it to milk powder and other dairy products.

The result of this protection was that virtually every farmer ran a dairy and therefore many unproductive producers were kept in the industry.

Since 1987 the Milk Board had begun to scale down its functions by, among other things, moving into the background as far as buying was concerned, leaving this function to private buyers with whom producers could negotiate the best price and the number of litres. Initially this went well because the price was good, but as production costs rose, the price adjusted more slowly and a cost squeeze situation developed. Producers gradually left the industry and notices of cattle sales became common.

Dairy farmers are not only exposed to the free market, but also to competition from dairy products that enter the country legally and illegally and are dumped on the market at low prices. It is therefore important to look at market indicators and the producer and milk organisations that were established in the place of the Milk Board to assist in marketing forecasts.

### 5.1 *Inflation rate*

The average inflation rate of the consumer price index was 15 percent per year till 1992, when it began to drop, to 7.4 per cent by 1996 (Finansies en Tegniek 1997, p48). The inflation rate of major overseas trading partners is still lower and South African producers can only compete if this figure remains low.

### 5.2 *The consumption of foodstuffs based on the expected growth rate of population groups*

Economic growth has an important influence on the change in the consumption pattern of foodstuffs. Milk does, indeed, compete with other agricultural products and it is important to take note and be aware of this. Milk and milk products do not enjoy a high priority and their consumption declines under a higher economic growth rate compared to other foodstuffs (Kleynhans & Liebenberg, p26).

The South African population grows by 2,5 percent per annum. It is estimated that the total population of 37 mil in 1990 will grow to 58 mil in 2010. The black population alone will grow by 19,3 mil from 15,9 mil to 35,2 mil, which gives an average growth of 5,95 percent per annum. It is estimated that the other groups will only grow by 1,8 mil over the same period, or 0,24 percent per annum (Kleynhans & Liebenberg 1994, p18). It is therefore expected that a large market for milk and milk products will expand among the black population, but their priority in terms of per capita expenditure is the lowest (Kleynhans & Liebenberg 1994, p24), only R33, compared to other foods as illustrated in Table 1 below:

**Table 1: Per capita expenditure on food by Black people in South Africa**

Food	Expenditure (Rand per capita)
Grain and grain products	111
Meat and meat products	219
Milk and milk products	33
Fruit and fruit products	41
Vegetables and vegetable products	74

*Source: Kleynhans and Liebenberg 1994*

Research and development on the marketing of dairy products to increase market share seems to be very important. Professional farm management goes hand in hand with effective marketing methods for sustainable dairy farming.

## 6. Nutrition and reproduction management

### 6.1 Introduction

If the basic management functions in terms of feeding and reproduction are not in place, the quality of breeding material is of lesser importance regarding the productivity of the dairy herd. Indeed, profitability can be negatively influenced as the cost of high quality breeding material is exorbitant and if the potential thereof cannot be realised, the exercise is futile.

The crucial aspects of dairy management are nutrition and reproduction. Management of nutrition begins with the raising of the replacement herd, namely the heifers. The ratio of cows to heifers must be as low as possible to minimise costs. Reproduction in the herd must be optimal, to allow selection on as high a level as possible in order to maximise the productivity of the herd in respect of milk production per cow and beef production. Once this is in place, the quality of breeding material can be addressed to maximise productivity and profit.

The management principles that are applied are relevant to every breed, but the standards are set to apply to Holstein, as this is the breed generally farmed in the Swartland.

### 6.2 The influence of growth rate and nutrition on production

Healthy udder development determines the milk production potential of a heifer. A heifer's feeding and growth rate goes hand in hand. It was found in practice that with a fast growth tempo prior to puberty, especially during the allometric growth phase (3 to 10 months age), milk production decreases. The effect of growth rate (feeding) on udder development is shown in Table 2.

**Table 2: The influence of growth rate and nutrition on udder development of Holstein heifers**

MEASUREMENT	GROWTH RATE	
	GDI* 0.623 Kg	GDI* 1.274 Kg
Starting age (months)	7.4	7.0
Starting weight (kg)S Starting weight (kg)	179.8	171.6
Age at puberty (months)	10.8	9.7
Slaughter age (months)	14.9	10.9
Slaughter weight (kg)	321.0	322.8
Total udder mass (kg)	1.7	2.2
Gland tissue (%)	38.0	22.0
Fat tissue (%)	62.0	78.0

\* General Daily Increase

Source: Carstens (1997)

The results in Table 2 show that a growth rate of 1,27 kg triggered off 78 percent fat tissue against 62 percent in the case of the lower growth rate. What is also important is that the growth rate of 0,62 kg per day resulted in 16 percent more gland tissue in the udder than the faster growth rate (Carstens 1997, p17).

### 6.3 The influence of shoulder height

The shoulder height and the weight of heifers are related. They serve as a measure of over- and underweight in the heifer's stages of development. The packing on of fat in the overweight animal leads to a decrease in production, while underweight animals experience reproduction problems. Underweight heifers, for instance, are only ready for mating later and this gives rise to associated complications. Animals must therefore be weighed regularly and their height be measured in order to administer nutrition appropriately. Table 2 shows what the relation should be between weight and shoulder height at any specific age.

**Table 3: Holstein Friesland Heifers: Body weight vs. Shoulder height**

Age	Holstein		Age	Holstein	
	Mass	Shoulder Height		Mass	Shoulder Height
Months	Kg	Cm	Months	Kg	Cm
Birth	39 – 45	74 – 76	10	254 – 296	111 – 119
1	59 – 70	80 – 84	11	277 – 322	115 – 121
2	77 – 95	85 – 89	12	300 – 345	118 – 123
3	102 – 119	89 – 94	13	322 – 368	120 – 125
4	123 – 145	94 – 98	14	340 – 393	121 – 127
5	145 – 170	97 – 103	16	369 – 439	124 – 130
6	167 – 195	101 – 107	18	420 – 481	127 – 132
7	189 – 221	105 – 110	20	564 – 529	129 – 135
8	212 – 245	107 – 113	22	488 – 557	131 – 140
9	231 – 271	110 – 116	24	522 – 613	132 – 143

Source: Carstens (1997)

The data in Table 3 is converted to a graph in Figure 7. The figure shows that weight gain is

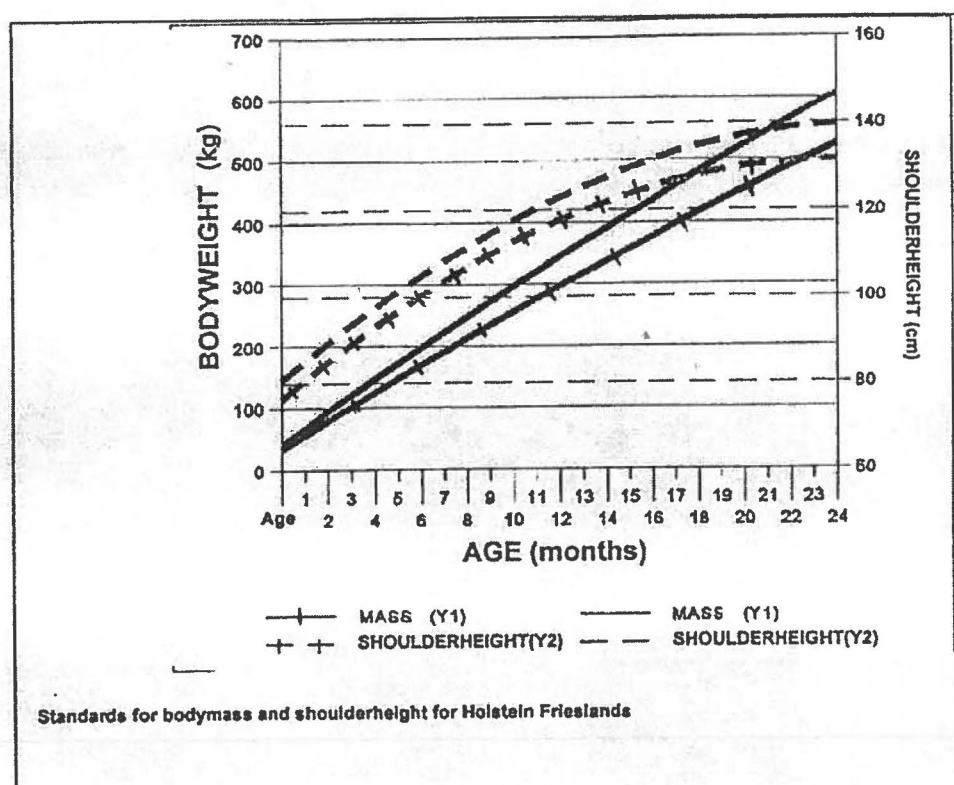


Figure 7. Standards for weight and shoulder height of Holstein Friesland heifers  
Source: Carstens (1997)

linear, while height levels out between 21 and 23 months. Owing to under-nutrition, heifers sometimes reach their optimum height only after 24 months. This inhibits production drastically and impacts negatively on the replacement herd ratio, as well as on the chance of improving the herd through selection. Interruption of the linear weight-gain sometimes occurs as a result of seasonal feed shortages. This can occur by adjustment of compensatory feeds.

As a criterion for the optimum herd composition, the following data in Table 4 is based on a herd of 100 animals.

**Table 4: A criterion for the composition of a herd**

Group	Percentage
Cows in production	42
Cows dry	9
Heifers 0-3 months (birth to weaning)	8
Heifers 4-6 months (feed in sheds)	7
Heifers 7-14 months (ready for AI)	16
Heifers 15-24 months (pregnant and calf)	18
Total	100

Source: Department of Agriculture: Western Cape (1989)

#### 6.4 First calving and the size of the replacement herd

Another option is merely to milk the cows and to buy in the replacement herd. This practice is seldom used, especially in the Swartland. Buying in of animals is not recommended, owing

to the danger of infection with transferable diseases like tuberculosis, brucellosis and others. Tests are done annually for infections and, if positive, all infected animals must be slaughtered. In this way the whole herd can be wiped out. In view of this, herds are run on a closed herd basis. When animals are bought, the new owner should insist on an indemnification certificate.

The raising of heifers is an important managerial function and there are advantages if it is carried out correctly. It is advisable to pay personal attention to this aspect, since it has the greatest influence on productivity. In Table 5 the influence of age at first calving on the replacement herd is shown. Producers who feed extensively and do not follow these guidelines will possibly not be able to survive.

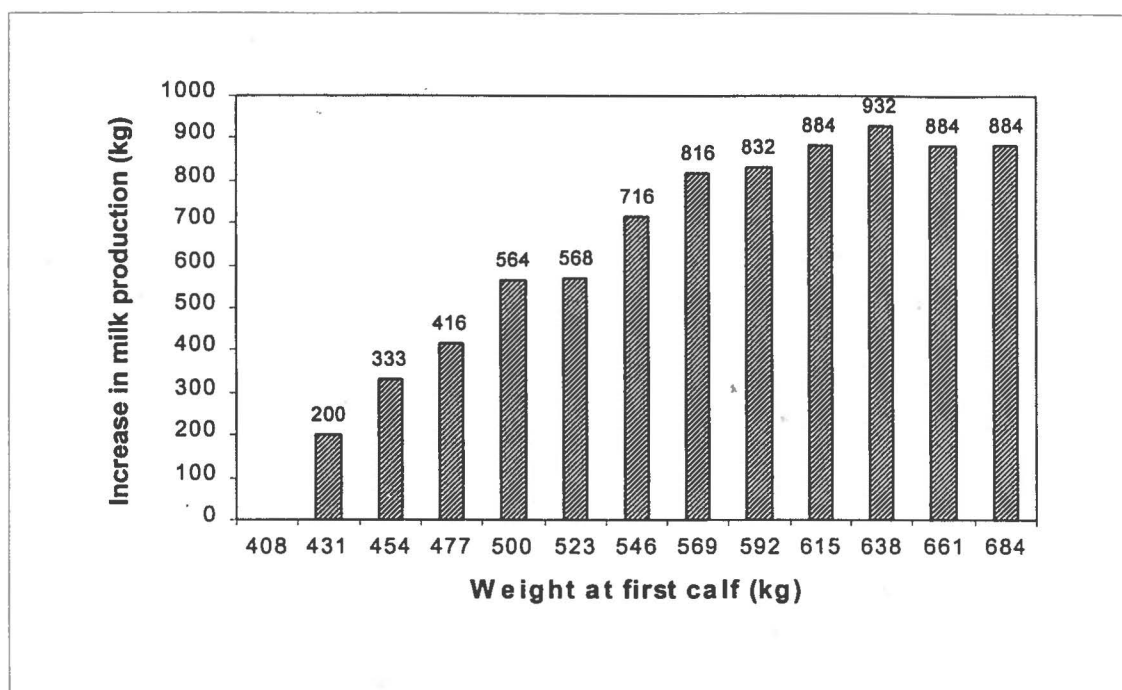
**Table 5: The effect of age with first calf on the size of the replacement herd**

First calving age (months)	Variation in replacement herd as compared to 24 months (%)
22	-8.4
23	-4.2
24	0.0
25	4.2
26	8.4
27	12.6
28	16.8
29	21.0
30	25.2
32	33.6
34	42.0
36	50.4

Source: Carstens (1997)

### 6.5 *Weight and milk production at first calf*

The weight at which a heifer calves has a great influence on her milk production in future. This also serves as a foundation for good production in the lactation to follow. Figure 8 demonstrates how a heifer's production increases as her weight increases at first calving. The highest increase in milk production takes place from 409 kg to 546 kg bodyweight.



*Figure 8. Relation between weight at first calf and increase in milk production*

*Source: Carstens (1997)*

Calving percentage is a very important standard for high productivity for cows in production. Ideally a cow should calf every 365 days, i.e. she must conceive 60 days after calving and then go out of production 65 days before she calves again to come into production for her next lactation. If she follows this calving cycle, her calving percentage will be 100 per cent. If the inter-calf period is longer, the calving percentage decreases. The disadvantage of a longer inter-calf period is illustrated in Table 6.

**Table 6: Calf percentage per annum as calculated from inter-calf period**

Inter-calf period (days)	Calf percentage (%)
365	100.0
385	94.6
405	89.1
425	83.6

*Source: Carstens (1997)*

One cause of a longer inter-calf period is that a cow does not conceive. This can be the result of poor heat observation due to hormone imbalances. High producers do not show clear signs of being on heat. An animal simply does not conceive if it suffers.

## **7. The sensitivity of the gross margin for producer prices**

Until the end of 1996 the producer's price for milk was 95–100 cents per kg. The milk price adjusted more slowly than the feed price. Profits were low and several farmers produced at a loss. Consequently, a number in the Swartland left the industry. The more efficient farmers remained and enlarged their dairies and consequently production remained constant. Prices increased substantially recently to 140 cents per kg and an over supply of milk is expected.

The price may stabilise on 120 cents per kg. In spite of the recent price fluctuation, the dairy industry in the Swartland remained stable compared to the feedlot systems in other provinces.

However, according to a survey done among twenty producers in the Swartland, the top third, being the more effective, still produced at a profit (refer to Table 7).

**Table 7: Results of the group survey of the Swartland dairy study-group**

Herd	Lower third	Average	Upper third
Cows in production (Dairy average)	205	220	190
Income and expenditure	Rand per cow in herd (per month)		
<b>Gross income</b>	<b>586.89</b>	<b>590.98</b>	<b>627.21</b>
Minus:			
Feed cost	450.45	431.31	403.67
Medicine and Veterinary	18.34	12.04	11.65
Artificial insemination	19.88	12.27	10.48
Diverse costs	47.54	36.59	26.04
<b>Gross margin</b>	<b>50.68</b>	<b>98.77</b>	<b>175.37</b>

Source: Van der Spuy (1995)

### 7.1 Price sensitivity

When the milk price increases fewer cows are slaughtered, the herd size increases and consequently total production increases. When production exceeds the demand the price may drop again. The profit margin is sensitive to price changes. The effect of milk price changes on the gross margin, based on a 100 cow in production-herd, is demonstrated in Table 8.

Producers in the Swartland and surrounding areas objected to producing at too low a price and stated their point of view. Milk buyers heeded their requests and the price rose to R1.40 per kg. A decrease in the average price to R1.30 leads to a decrease of 36,8 percent in the gross margin. Should the price drop another 10 cents to R1.20 per kg the gross margin drops 56.2 per cent. According to Table 8 a dairy cannot operate at a profit at a price lower than 110 cent per kg. Due to the inflation factor, regular updating of the figures is necessary.

**Table 8: The influence of changes in the producer price on the gross margin of a feedlot system (100 Friesland cows in production)**

Producer price Cent per kg	Gross income R	Variable costs R	Gross margin R
100	1 037 300	1 145 785	-108 485
110	1 125 800	1 145 785	-19 985
120	1 216 800	1 145 785	71 015
130	1 307 800	1 145 785	162 015
140	1 402 300	1 145 785	256 515

Source: Dept. of Agriculture: Western Cape (1997)(Combud)

## 8. Linear Programming (LP) to maximise farm profits

Irrespective of the planning technique used, the quality of the results depends totally on the data and the extent to which the real characteristics of the farming activities are reflected in the model. The fact that some techniques require less data often reflects the inability of those methods to accommodate important relationships between variables. Linear programming is often more time consuming than other planning methods due to its ability to accommodate complex farming systems in the planning model. No other method has the ability to handle complex relationships in an optimising model (Louw, 1996,p3). The technique of linear programming has the capacity to consider simultaneously thousands of variables and attribute limited resources to activities. The benefit is that the best possible project is developed, given the data used. No other more profitable plan can be drawn up without altering the resources or the restrictions. Linear programming will be used in this project to address two problems, namely:

- To find the least-cost feedstuff-mix for the dairy by considering farm produced as well as purchased feedstuff. The feeding requirements of the feedstuff mix will be deduced with the aid of feeding experts.
- To analyse the viability of producing the ingredients of the least-cost feedstuff-mix as part of the crop rotation system on a typical Swartland farm. Should the content of the planning problem require a multi-period approach, the dynamic linear programming model, OPTIMA, that has been developed and applied by Louw (1996) as a planning model in the South Coast region, will be used in this project to optimise the combination of farm enterprises. It is only recently that dynamic linear programming came into practice more generally, mainly due to more advanced computer technology. Data regarding the present farming situation, but with the emphasis on a detailed economic-financial analysis of the dairy-enterprise was surveyed at leading farms in the area. Present practices were identified and their validity, given the present state of technology, was discussed in workshops with industry experts. This modus operandi will further the verification of the data that will be used in the planning model.

### 8.1 *Applications of the Optima Dynamic Linear Programme on farm level*

The Optima Model was developed on the microcomputer for economic planning on farm level. The model can be applied to:

- describe the present farming enterprises in terms of available resources
- compose budgets of alternative enterprises
- generate alternative farm plans
- report on cash flow, capital flow, resource uses and sensitivity analysis, etc. (Louw 1996, p129).

An example of a farm plan in the South Coast region, projected over six years with the Optima program is illustrated in Table 9. Three plans are presented, the results of which can thus be compared. They are:

- the present plan
- the optimum plan, and
- the revised plan should the price of red meat increase by 30 percent due to export possibilities.

It appears from the results in Table 9 that the net present value (NPV) over six years increased by R1 331 617, if grain production was increased by 653 ha over the same period and the pastures were decreased by 644 ha.

Should the meat price rise by 30% it is expected that the NPV will rise by R1 073 710 over the six-year period. The grain: pasture relation remained unchanged with a small increase in beef cattle.

**Table 9: Comparing results of different farm plans**

Activity	Present Plan	Optimum Plan	Red Meat 30% price increase
Wheat (ha)	1 363	1 592	1 223
Barley (ha)	1 683	2 104	2 262
Canola (ha)	0	0	0
Feed grain (ha)	14	17	0
TOTAL GRAIN	3 060	3 713	3 485
Lucerne (ha)	3 032	2 300	2 025
Medics (ha)	362	68	580
Oats (ha)	178	615	563
Fallow land (ha)	65	10	19
Total pasture (ha)	3 637	2 993	3 187
Silage (ha)	45	17	0
Beef cattle	75	148	169
Dairy	106	150	150
Sheep	375	343	444
Total LSU <sup>1</sup>	556	641	763
NPV <sup>2</sup>	2 197 899	3 529 516	4 603 226
Income: crops	49,9%	49,9%	48,0%
Income: cattle	50,1%	50,1%	52,0%
Expenses: crops	57,0%	60,0%	57,0%
Expenses: cattle	43,0%	40,0%	43,0%

1. LSU Large stock units

2. NPV Net present value of cash flow over the planning period at a discounting rate of 6%

Source: Louw (1997)

### 8.2 The Net Present Value (NPV) of the cash balance after replacement of capital items

The NPV's in Table 9 do not include the cost of the replacement of capital items. The calculation should include these items in order to evaluate the economic feasibility of the plan.

The model can therefore be implemented to measure the cash flow in terms of the balance of the NPV after capital items were purchased during the period. The NPV of the capital items purchased is R1 228 996. The plan in this example is economically feasible because the present value (PV) of the net cash income (NCI) minus the PV of the expenditure on capital items is positive as indicated by the amount of R2 300 520 in Table 10.

**Table 10: Net Present Value of the cash balance after replacement of capital items**

Year	NCI <sup>1</sup>	NPV <sup>2</sup>	Capital Items	NPV	Balance:
0	0	0	250 000	250 000	-250 000
1	773 800	730 000	0	0	730 000
2	707 324	629 516	500 000	444 998	184 518
3	661 014	555 000	0	0	555 000
4	650 176	515 000	600 000	533 998	-18 998
5	749 406	560 000	0	0	560 000
6	766 000	540 000	0	0	540 000
PV of NCI		3 529 516		1 228 996	
PV <sup>3</sup> of the NCI minus PV of Capital replacement					2 300 520

1. NCI – Net cash Income

2. NPV – Net Present Value

3. PV – Present value of net cash flow at a discounting rate of 6%, including capital expenditure

Source: Louw (1997)

## 9. Conclusion

Dairy farming on feedlots in the Swartland requires super management for sustainability. Due to a constant rise in production costs, higher standards of management will be required. The topics discussed in this paper are guidelines to improve the sustainability of dairy farming. It requires the specialist attention of a herdsman, a feeding consultant for optimum growth and production and an economist to analyse the economic indicators to take correct precautionary decisions.

The linear programming model, OPTIMA, that has been developed and applied by Louw (1996) as a planning model in the South Coast region, will also be applied in this project to assist in optimising the combination of farm enterprises in the Swartland region.

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