

**Development of different technical, economic and  
financial benchmarks as management tool for  
intensive milk producers on the Highveld of South  
Africa**

by

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A thesis submitted in partial fulfilment of the requirements for the  
degree of

M.Sc. (Agric) Agricultural Economics

in the

Department of Agricultural Economics, Extension and Rural  
Development

Faculty of Natural and Agricultural Sciences

University of Pretoria

Pretoria

January 2007

## ACKNOWLEDGEMENTS

With the completion of this study there are a number of people I would like to thank. Without family, friends and colleagues this study would not be possible. I would like to express a special word of thanks to the following:

- God, for the strength, determination, knowledge and ability to study, not only in academics, but also in life.
- My parents, for teaching me to be the best I can be and giving me the freedom to do my thing in life. Thank you for all the opportunities you gave me.
- My wife, Isobelle, for all the encouragement, patience and love during the study. Thank you that you believe in me and love me.
- My sisters, Marthie, Ronnie and Emsie for the support you gave me during my years of study.
- Dr Koos Coetzee for all the help with the study, and for being a mentor and benchmark that I can look up to.
- My friends and colleagues, who are too many to name, for understanding and support during my studies.
- The experts in the various fields for their information, help and time available during the study: Prof Dirk Lourens, Prof Lourens Erasmus, Dr Nico Schutte, Mr Jas Wasserman and Mr Mike van den Berg.
- Prof Chris Blignaut for guiding me and giving input throughout the study.
- The Milk Producers' Organisation for giving me the opportunity to complete the study.

# **AN INVESTIGATION INTO THE IDENTIFICATION OF DIFFERENT TECHNICAL, ECONOMIC AND FINANCIAL BENCHMARKS AS MANAGEMENT TOOL FOR INTENSIVE MILK PRODUCERS**

by

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## **ABSTRACT**

Extensive studies have been done in the various fields of dairy production such as, reproduction, herd and animal health, feeding and nutrition and the economics of milk production. This study aims to incorporate the standards or benchmarks set out in these studies, in order to identify different technical and financial benchmarks that can be used as management tool by intensive milk producers.

Benchmarking can be described as a process whereby a firm (farm) compare its processes, results or actions against that of competitors with the best practice in the industry. To become competitive a farm business must have the ability to compare (benchmark) itself against others, and preferably against others that perform better, but also make adjustments according to the

comparison. Benchmarking is therefore a continuous process of comparing and adjusting where necessary.

The dairy industry in South Africa changed dramatically since deregulation in the early 1990's. The industry went from a highly regulated one-channel market to a completely free-market system. This meant that farmers had to become more competitive, both locally and internationally.

Three different types of production systems are used in the six production regions in South Africa. These production regions can be divided into two main regions: the coastal regions and the Highveld region. Production in the coastal regions is normally pasture-based, with additional concentrate feeding in some cases. On the Highveld and in the Western Cape, production is based on a total mixed ration (TMR), where cows are fed the complete ration in an intensive production system.

Benchmarks were identified for herd health and reproduction, feeding and nutrition and economic and financial performance. Lastly, some additional general benchmarks were defined for bio-security and capacity utilisation. Herd health and reproduction can be divided into the three main areas of fertility performance, udder health and general herd health. Nutrition and feeding can be divided into benchmarks for: intake, nutrient requirements, body condition scoring, calf and heifer feeding, and additional general feeding benchmarks. The economic and financial performance of the dairy farm business can be evaluated against benchmarks for costs, solvability, liquidity, profitability, debt repayment and capital efficiency.

It is very important to note and remember that when a dairy farm is evaluated, all the norms or benchmarks must be seen in a holistic way. All the parameters, and therefore every benchmark, are interrelated and cannot be judged or applied individually. Feeding will have an impact on production and reproduction and therefore on financial performance.

This study focuses only on benchmarks for intensive milk producers, but it is recommended that it can be extended to include benchmarks for milk production in the pasture-based production systems as well. Since the dairy industry operates in a free-market system and South Africa is an open economy, it is important to be globally competitive. This can only be achieved if local producers benchmark themselves against international standards. Benchmarks can only be used if they are quantified. It is therefore recommended that benchmarks are published for the dairy farmer to use in his evaluations. The Nominal Group Technique worked well to establish the parameters and their benchmarks and farmers can also benefit from this technique. All related parties to the dairy farm, such as the financial consultant or agricultural economist, animal nutritionist, veterinarian and other input suppliers can form a specialist group to evaluate the performance of the dairy together with the producer or herd manager. This specialist group can then recommend adjustments to be made, after discussing the effects on every aspect of production.

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# CHAPTER 1: INTRODUCTION

## 1.1 Background

During the past ten years the dairy industry in South Africa underwent a lot of changes<sup>1</sup>. It was one of the first industries to start with deregulation from a single channel marketing system to a totally free-market system. These changes also resulted in changes to farmers' production systems<sup>2</sup>. Farmers had to become more efficient in managing input costs and production output, in order to be profitable in the industry. Stable and declining producer prices coupled with increasing production costs, resulted in a significant number of farmers leaving the industry<sup>3</sup>.

In the controlled marketing environment, the different industry boards collected information regarding production, input costs, statistics, etc. With the shift to a more competitive free-market system, this information became scarce and farmers found it difficult to measure their economic and financial performance against other farmers. Cronje, *et al* (1999) noted that information is essential in the free-market system and one of the tasks of a producer organisation should be the collection and distribution of information to its members.

Cronje, *et al* (1999) indicated that there exist competitive advantage differences among farms and also between regions. Only if milk production is profitable in the medium term, is it possible to survive financially. Benchmarking is generally known in business, with firms competing against each other. But one can not compete effectively if you can not compare against the current best practise in that particular industry. By using benchmarking, or best practise analysis, the firm, or farmer in this case, can establish the areas where changes must be made in order to become more

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<sup>1</sup> See Chapter 1.2 and Appendix A

<sup>2</sup> See Chapter 1.2.2

<sup>3</sup> See Chapter 1.2.3

efficient. The whole exercise of benchmarking is therefore to bring forth change, and continue changing while striving to become the best.

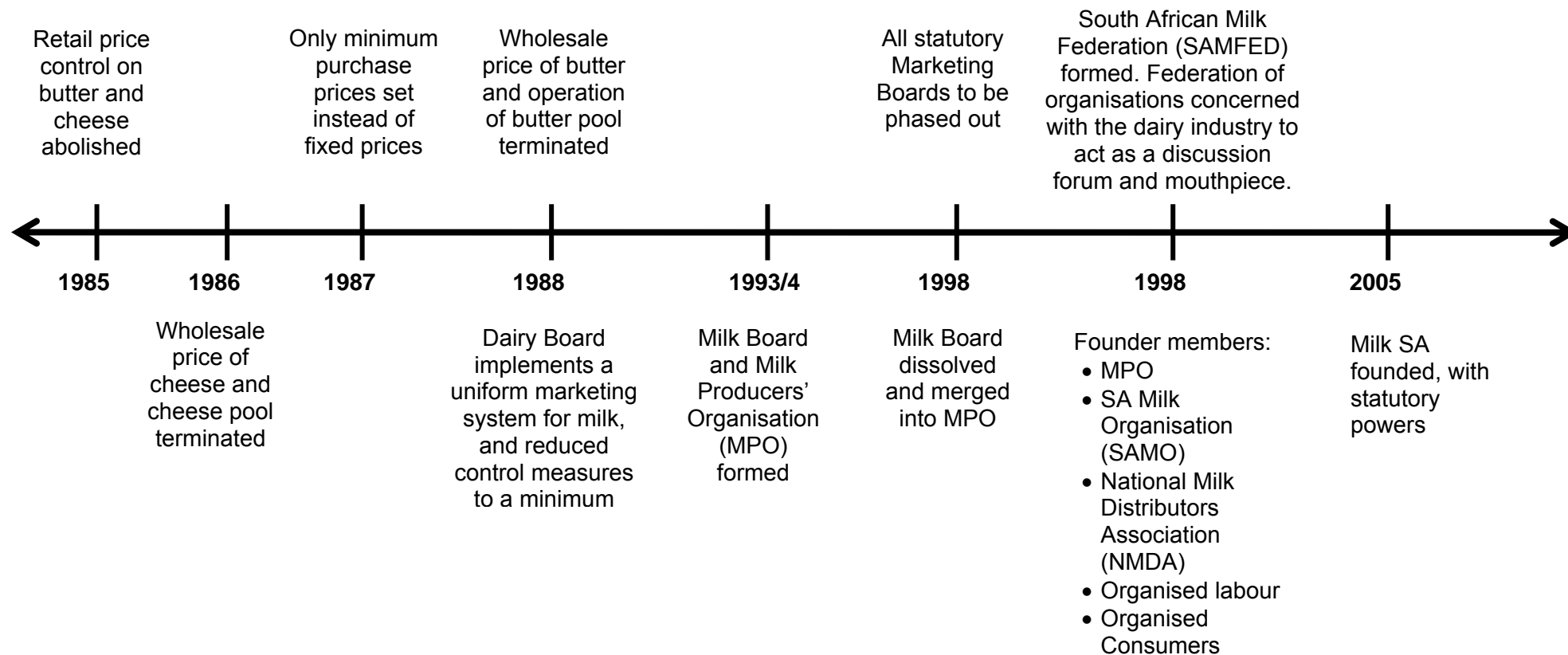
## **1.2 The South African Dairy Industry**

### **1.2.1 Introduction and History of the South African Dairy Industry**

The face and structure of the South African Dairy Industry has changed dramatically over the last 15 years. Not only have the market environment changed from a highly regulated one-channel market to a totally free-market system, but there was also a decline in producer numbers that resulted in a sharp increase in the size of farm enterprises, shifts in the important production regions and huge improvements in technology that is being used in dairies. This improvement in technology on its own leads to changes in management systems, cost structures, number of cows in herd and production per cow.

The marketing environment changed over the last 15 years. Cronje, *et al* (1999) gave a timeline of the gradual deregulation over a 14-year period of the dairy industry, as shown in Figure 1.1.

A brief overview of the history of the Dairy Board, Milk Board and Milk Producers' Organisation is given in Appendix A1.

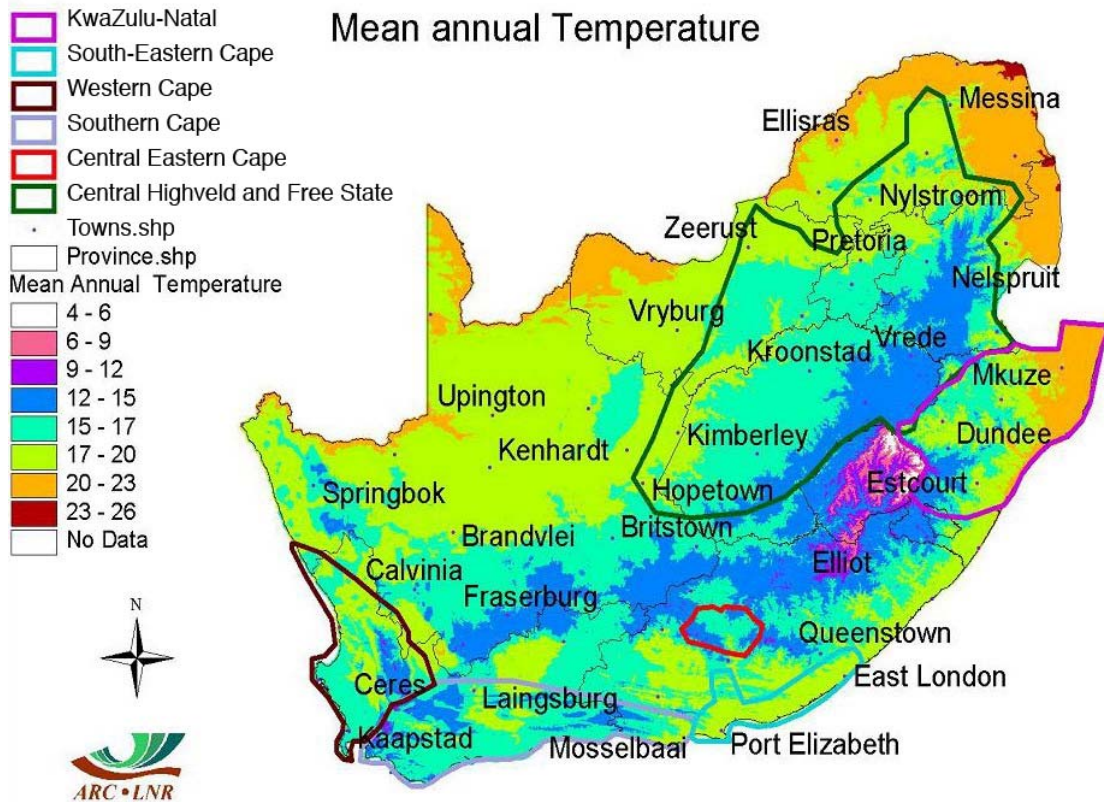


**FIGURE 1.1: Progress in South African dairy industry deregulation**

## 1.2.2 Milk Production Regions and Systems in South Africa

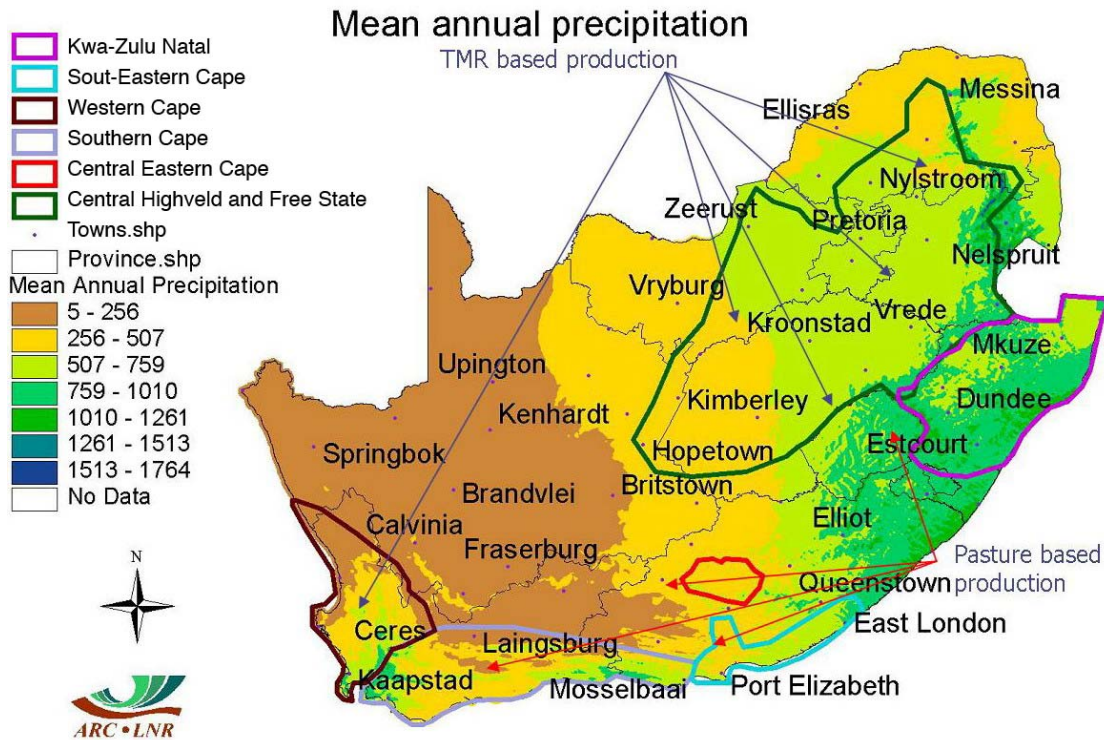
### 1.2.2.1 Production Regions

Climate, temperature and rainfall and location relative to the consumer market, plays a very important role in the production of milk, and especially in the type of system that is being used. Figure 1.2 depicts the mean annual temperature of South Africa, with the milk producing regions within the country. Figure 1.3 shows the mean annual precipitation within the production regions. Figure 1.3 also depicts the different production systems that are commonly used in the different climatic regions.



Source: Dairy Development Initiative, Samfed, 2000

**FIGURE 1.2: Mean annual temperature and milk producing regions, 2007**



Source: Dairy Development Initiative, Samfed, 2000

**FIGURE 1.3: Mean annual precipitation and milk producing regions and systems, 2007.**

Producers in the coastal areas, with more moderate temperatures and higher rainfall, are predominantly on pasture-based production systems, except for the Western Cape where they are on Total Mixed Ration (TMR) production systems. The Highveld and other inland areas, with more fluctuating temperatures and lower rainfall, are mainly TMR-based regions. There are a few exceptions on the Highveld where producers with enough water make use of pasture-based production systems.

According to *Lacto Data* (October 2006) there were 1654 (41%) milk producers in the coastal provinces (Western Cape, Eastern Cape and KwaZulu-Natal) and 2384 (59%) in the inland provinces (Limpopo, Mpumalanga, Gauteng, Northwest, Free State and Northern Cape). With regards to the geographical distribution of milk production the opposite distribution holds. See Table 1.1.



**TABLE 1.1: Geographical distribution of milk production, 1997 and 2004**

Province	% of National milk production	
	Dec 1997	Dec 2004
Western Cape	22,9	24,5
Eastern Cape	13,8	20,5
Northern Cape	1,2	0,7
KwaZulu-Natal	15,7	19,0
Free State	18,0	13,4
Northwest	12,6	10,3
Gauteng	4,4	3,9
Mpumalanga	11,0	7,1
Limpopo	0,4	0,6
<b>TOTAL</b>	<b>100</b>	<b>100</b>
<i>Coastal Provinces</i> <sup>4</sup>	<i>52,4</i>	<i>64,0</i>
<i>Inland Provinces</i> <sup>5</sup>	<i>47,6</i>	<i>36,0</i>

Source: *Lacto Data*, Vol 9(2), October 2006

### 1.2.2.2 Production Systems

It is important to note that different production systems exist for the South African dairy industry. In some cases the difference between the production systems will result in variations between the benchmark for a certain parameter.

Three different production systems are used in the production of milk in South Africa, namely;

1. Total Mixed Ration (TMR) based,
2. Concentrate and roughage based, and
3. Pasture-based.

#### 1.2.2.2.1 Total Mixed Ration Based Production System (TMR)

The definition of a TMR-based production system is that, based on her production potential, a cow is fed a complete ration. It is normally under

<sup>4</sup> Coastal provinces: Western Cape, Eastern Cape and KwaZulu-Natal

<sup>5</sup> Inland provinces: Northern Cape, Free State, Northwest, Gauteng, Limpopo, Mpumalanga

feedlot conditions with *ad lib* roughage plus concentrates or the feeding of a total mixed ration. This system allows farmers to feed cows in groups or individually according to their production.

Roughage is normally in the form of silage, lucerne and hay, while maize and other grains make up the concentrates at 350-500g/kg milk per day. Protein sources are in the form of oil cake (cotton oilcake, soybean oilcake, etc), fishmeal and urea. The composition of the ration is made of 50%-70% concentrates and 50%-30% roughage.

This kind of production system is commonly associated with cows with high production averages that are housed.

#### **1.2.2.2 Concentrate and Roughage Based Production System**

The definition of this production system is that less than 50% of dry material intake originates from pastures. Cows graze on pastures for a part of the day and for a part of the year. Concentrates are fed separately in troughs or together with roughage. Normally the concentrates are fed in or before entering the milking parlour.

Roughage can vary from low quality harvest rests to high quality silage, hay and lucerne, while concentrates are the standard concentrates (grains) in the form of bought or self-mixed concentrates. Concentrates are fed at 250-350g/kg milk per day. This type of production system is commonly found in the grain producing areas.

#### **1.2.2.2.3 Pasture-Based Production System**

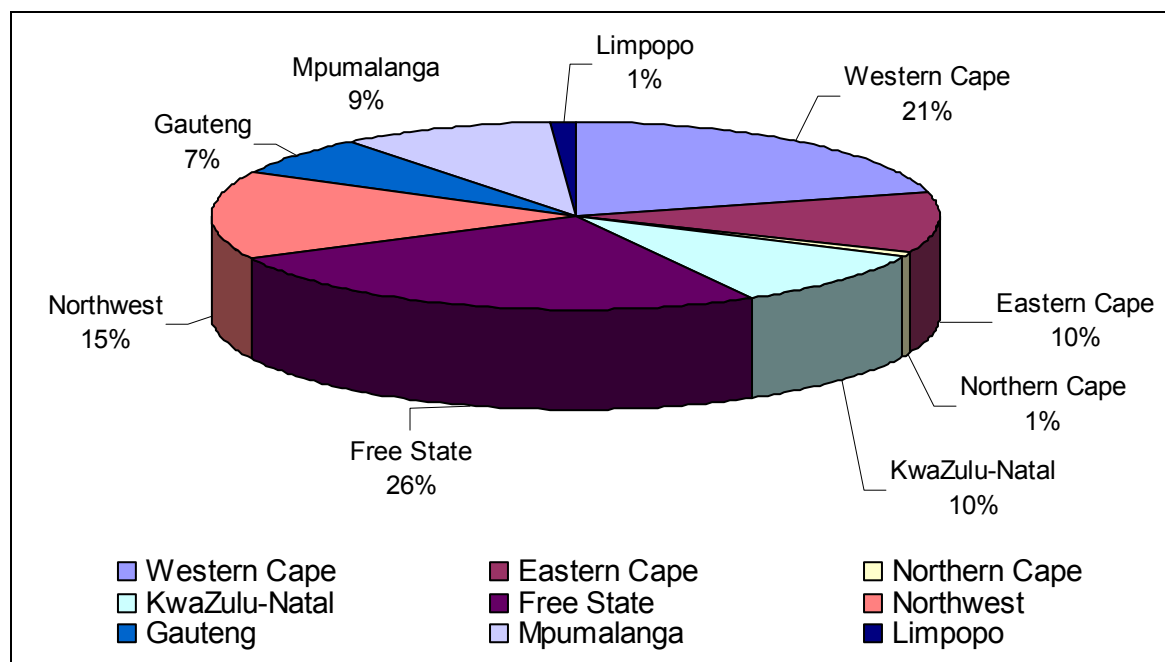
In a pasture-based production system more than 50% of dry matter intake originates from pastures. Cows are on the pastures almost throughout the year, but supplementary roughage may be fed for a short period (especially during the drier months). Farmers may also opt to feed a small quantity of concentrates in the milking parlour.

Roughage is normally in the form of rye grass and clover mixes, or other pasture species. Standard concentrates may be fed in the milking parlour at 150-250g/kg milk per day. This production system is normally used in the irrigation or high rainfall areas, such as the Eastern and Southern Cape and the Natal Midlands.

### 1.2.3 Structure of the South African Dairy Industry

#### 1.2.3.1 Primary Industry

In 1994/95 there were 7317 milk producers according to the Annual Report of the Milk Board<sup>6</sup>. During 2006 the primary dairy industry in South Africa consisted of 4 030 milk producers, producing milk in all the provinces of the country (Table 1.2). The number of producers per province and in total declined substantially from December 1997 to August 2006 (Table 3.2). The distribution of producers per province is shown in Figure 1.4.



Source: MPO Statistics

**FIGURE 1.4: Percentage distribution of milk producers per province, August 2006**

<sup>6</sup> Annual Report 1994/95 Milk Board.

Although the coastal provinces<sup>7</sup> have the smaller percentage of producers (Table 1.2: 41%), these provinces produce 64% (Table 1.1) of the national milk production.

**TABLE 1.2: Number of milk producers per province, 1997 - 2006**

Province	Dec 1997	Dec 2002	Aug 2006	% Change 1997 - 2006
Western Cape	1 577	1 005	845	-46
Eastern Cape	717	486	418	-42
Northern Cape	133	75	39	-71
KwaZulu-Natal	648	451	391	-40
Free State	1 204	1 331	1 030	-14
Northwest	1 502	942	616	-59
Gauteng	356	292	266	-25
Mpumalanga	866	523	378	-56
Limpopo	74	65	47	-36
<b>TOTAL</b>	<b>7 077</b>	<b>5 170</b>	<b>4 030</b>	<b>-43</b>
<i>Coastal provinces</i>	<i>41,6%</i>	<i>37,6%</i>	<i>41,0%</i>	
<i>Inland provinces</i>	<i>58,4%</i>	<i>62,4%</i>	<i>59,0%</i>	

Source: *Lacto Data*, Vol 9(2), Oct 2006

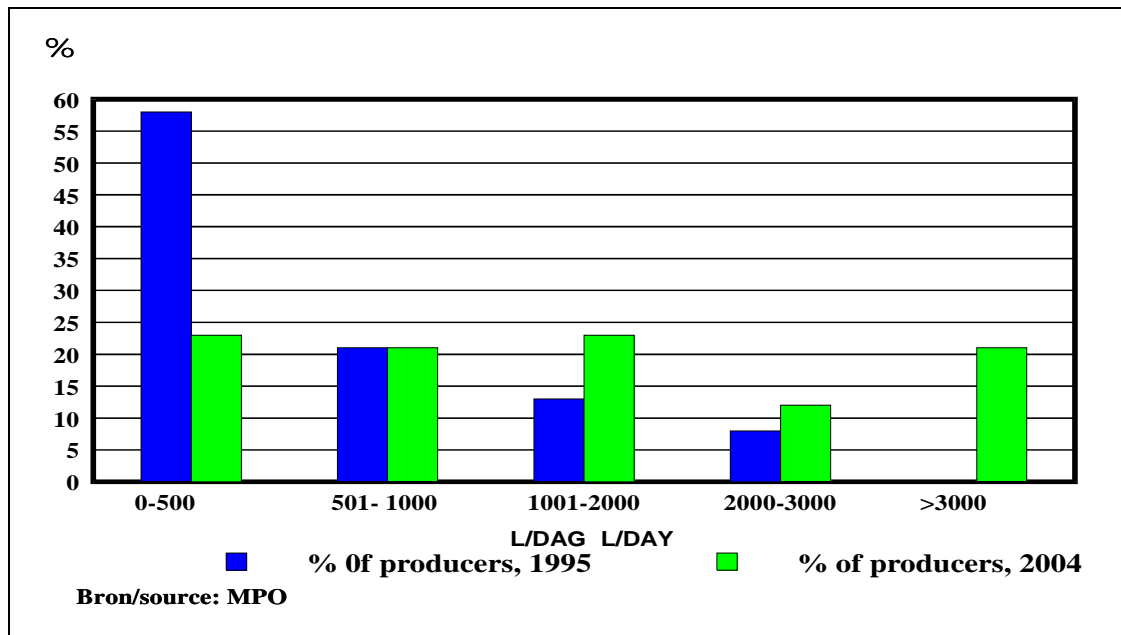
From Table 1.1 it is possible to see a shift in the geographical distribution of milk production. In December 1997 52,4% of milk were produced in the coastal regions. This increased to 64% in December 2006, with the Eastern Cape gaining the most from the production shift.

<sup>7</sup> Coastal provinces: Western Cape, Eastern Cape and KwaZulu-Natal

**TABLE 1.3: Average production (litres/day) per herd, 1997 vs 2004.**

Province	1997	2004	% Change 1997 vs 2004
Western Cape	796	1 541	93
Eastern Cape	1 054	2 440	131
Northern Cape	494	992	100
KwaZulu-Natal	1 328	2 692	103
Free State	819	682	-16
Northwest	460	815	77
Gauteng	677	792	16
Mpumalanga	696	948	36
Limpopo	296	711	140
<b>TOTAL</b>	<b>774</b>	<b>1 288</b>	<b>66</b>

Source: *Lacto Data*, Vol 9(2), Oct 2006



Source: *Lacto Data*, Vol 9(2), Oct 2006

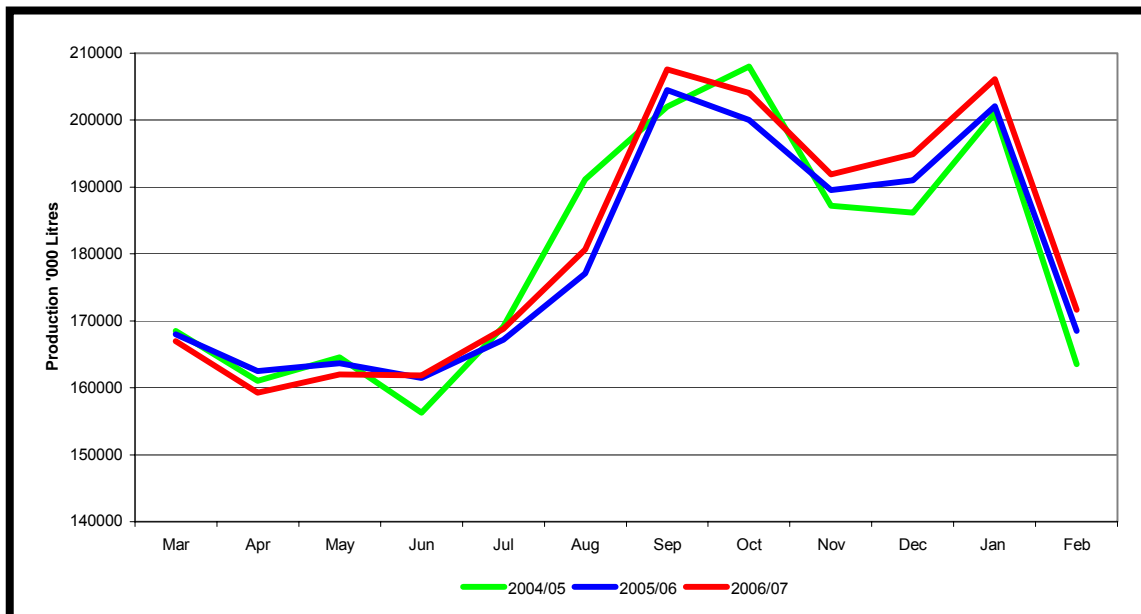
**FIGURE 1.5: Production per dairy herd in litre/day, 1995 and 2004.**

Although the number of producers declined from 1997 to 2006, the average production per herd per province, except the Free State, increased (Table

1.3). This can be an indication of the increased efficiency of the modern milk producer in South Africa.

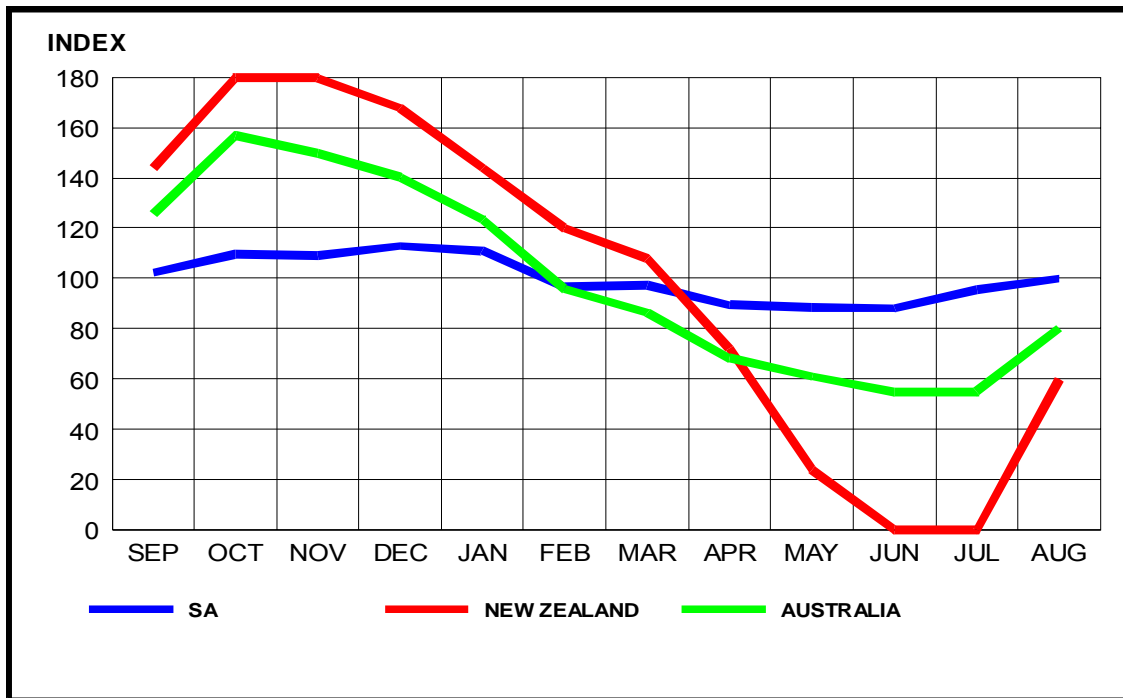
The production capacity of herds also changed since 1997. In 1995 the majority of producers (58%) produced less than 500 litres per day, with 20% producing more than 1000 litres per day (Figure 1.5). Due to changes in the dairy industry since 1995, dairy herds grew in size, producing more per cow (MPO Statistics). In 2004, slightly more than 20% of dairy herds produced less than 500 litres per day, while 57% produced more than 1000 litres per day (Figure 1.5).

South Africa has a seasonal production trend, with peak production in the months of September, October and December, and lows from April to June. Figure 1.6 gives an indication of the monthly milk production for the periods 2004/05 to 2006/07.



Source: MPO Statistics, November 2006

**FIGURE 1.6: Monthly milk production – South Africa**



Source: MPO Statistics, November 2006

**FIGURE 1.7: Seasonal production trend – South Africa vs Australia and New Zealand**

Comparing the seasonal production trends for South Africa, New Zealand and Australia, two countries with which South African milk production is normally compared, (Figure 1.7), it is clear that South Africa’s seasonal variation in production is the lowest.

### 1.2.3.2 Secondary Industry

The secondary industry consists of more than 230 milk buyers and 490 producer-distributors (PD’s) (Table 1.4). There are only five major national milk buyers in South Africa, namely Clover SA (previously NCD), Parmalat, Dairybelle, Nestlé and Woodlands, that control the majority (70%) of the milk in South Africa. According to the NAMC report (2001), no uniform milk purchasing system is applied. The major buyers use comparative base-pricing purchasing systems (price is determined by milk solids composition, volume premiums and milk quality), while smaller processors tend to purchase milk solely on a volume basis.

Smaller milk buyers and producer-distributors play a large role in the fresh milk sector, while the major milk processors still play the most important role in the formal sector, including fresh milk and milk products, such as cheese, yoghurt and milk powder. A producer-distributor is defined as a producer who processes and sells only the milk he produces on his farm. He therefore buys no milk from other producers. With the increase in the number of producer-distributors, it is evident that there is a trend towards on-farm value-adding and the utilisation of niche markets.

**TABLE 1.4: Number of PD's and milk buyers per province, 2003 and 2006**

Province	Producer-Distributors		PD's as % of producers	Milk buyers	
	Jun 2003	Aug 2006	Aug 2006	Jun 2003	Aug 2006
Western Cape	38	35	4,7	48	42
Eastern Cape	43	57	14,8	25	19
Northern Cape	27	24	61,5	8	6
KwaZulu-Natal	40	40	11,8	36	21
Free State	63	115	11,3	54	32
Northwest	50	53	9,7	46	25
Gauteng	73	73	28,6	100	68
Mpumalanga	46	62	18,3	38	19
Limpopo	35	32	63,8	10	4
<b>TOTAL</b>	<b>415</b>	<b>491</b>	<b>12,9</b>	<b>365</b>	<b>236</b>

Source: *Lacto Data*, Vol 9(2), Oct 2006

#### 1.2.4 Summary of the Dairy Industry in South Africa

The organised dairy industry in South Africa went through a lot of changes, from a totally controlled market to the current free-market system. This in itself brought some new challenges to the declining number of producers in South Africa.

Given the different climatic regions in South Africa, there are also different production systems in use in the primary industry. The main production



regions are the coastal regions, with its higher rainfall and moderate climate. The coastal provinces produce 64% of the total milk production, with 41% of the producers. The production systems used by South African dairy producers range from total mixed ration systems to totally pasture-based systems, with different combinations of the two systems in between. Production follows a seasonal trend, more stable in pattern than Australia and New Zealand, with the peak production during the summer months and the lowest production in the winter months.

The number of producers is declining, but the average production per producer is increasing, which is an indication of improved efficiency. There is a trend toward less, but larger dairy herds. There was also a clear shift in production, and producers from the inland provinces (the Highveld) moved towards the coastal provinces, especially to the Eastern Cape Province.

### ***1.3 Purpose of the Study***

The purpose of this study is to identify, define and quantify certain critical benchmarking norms or standards against which dairy farmers can evaluate themselves in order to be firstly, sustainable and secondly, profitable. Only critical benchmarks will be noted to use in the evaluation of a dairy herd, producing milk in the Highveld region, under a total mixed ration-based production system.

### ***1.4 Limitations of the Research***

Doing research on production costs in the South African dairy industry poses some limitations and problems, which is characteristic of the structure of the industry in South Africa. These limitations are:

- Different production systems: Dairy farms differ in terms of production systems used. For this reason it was also decided to make use of the

Nominal Group Technique, to get the opinions of experts in the different fields of dairy farming, rather than to use individual farmers' data to establish benchmarking norms.

- Farm size: There is no average farm size for dairy farms on the Highveld, or anywhere, which limited the use of farmers' data and poses a problem for setting averages for production costs or technical norms.
- Dependability of norms: This is the biggest limitation in setting norms or standards within the primary dairy industry. Most of the production factors are so closely linked and it might be difficult to attach values to it. It is also important to note that one must evaluate the dairy farm operation as a whole, since the factors are so closely linked.

### ***1.5 Outline of the Chapters***

The outline of the study is as follows: In Chapter 2 a closer look is taken at benchmarking; Chapter 3 deals with the benchmarks or norms which were identified for the intensive dairy producer in South Africa and in Chapter 4 the study is summarised and concluded, with a few recommendations.

## CHAPTER 2: METHODS AND PROCEDURES

### **2.1 Introduction**

The dairy profit equation is quite simple: Profit = (price – cost) per unit x volume. Judging the three elements independently and with the ceteris paribus assumption in place, the following three changes will increase profitability:

1. Increase Price,
2. Decrease Cost,
3. Increase Volume.

Process benchmarking as generally practiced, is accredited to Xerox who decided in 1979 to examine and compare unit costs with those of their Japanese competitors (Hanlon, 1999:1).

Xerox discovered that the Japanese products were sold for less than their own production costs. This resulted in the implementation of detailed examinations of every process in the Xerox manufacturing chain, and comparing that with those of their competitors. The result was that Xerox became one of the world's most formidable competitors in the photocopier market. But the difference was that Xerox had followed through; they did not rely on numbers alone, but identified the causes of their high production costs and introduced a rigorous improvement programme.

According to Hanlon (1999,1), a form of benchmarking, *comparative performance analysis*, has been around for decades. It has been confined to a comparison of some productivity and financial measures.

The technical nature of the initial knowledge transfer activity is seen as a means of engagement with potential participants, while the introduction of the benchmarking activity serves as a transition toward the consideration of

financial performance, sustainability and longer term business strategy, and aims to provide an awareness of financial performance and the manner in which it relates to the achievement of personal and business objectives (Bariball *et al*, 2005:390). Benchmarking can facilitate the transfer of management tools to farmers with the objective to improve competitiveness.

According to Hanlon (1999:6) a survey of some 500 manufacturing businesses in Australia and New Zealand indicated that the leaders in the sector are those who benchmark. They also seek to benchmark themselves against overseas competitors in order to improve international competitiveness within their own operation.

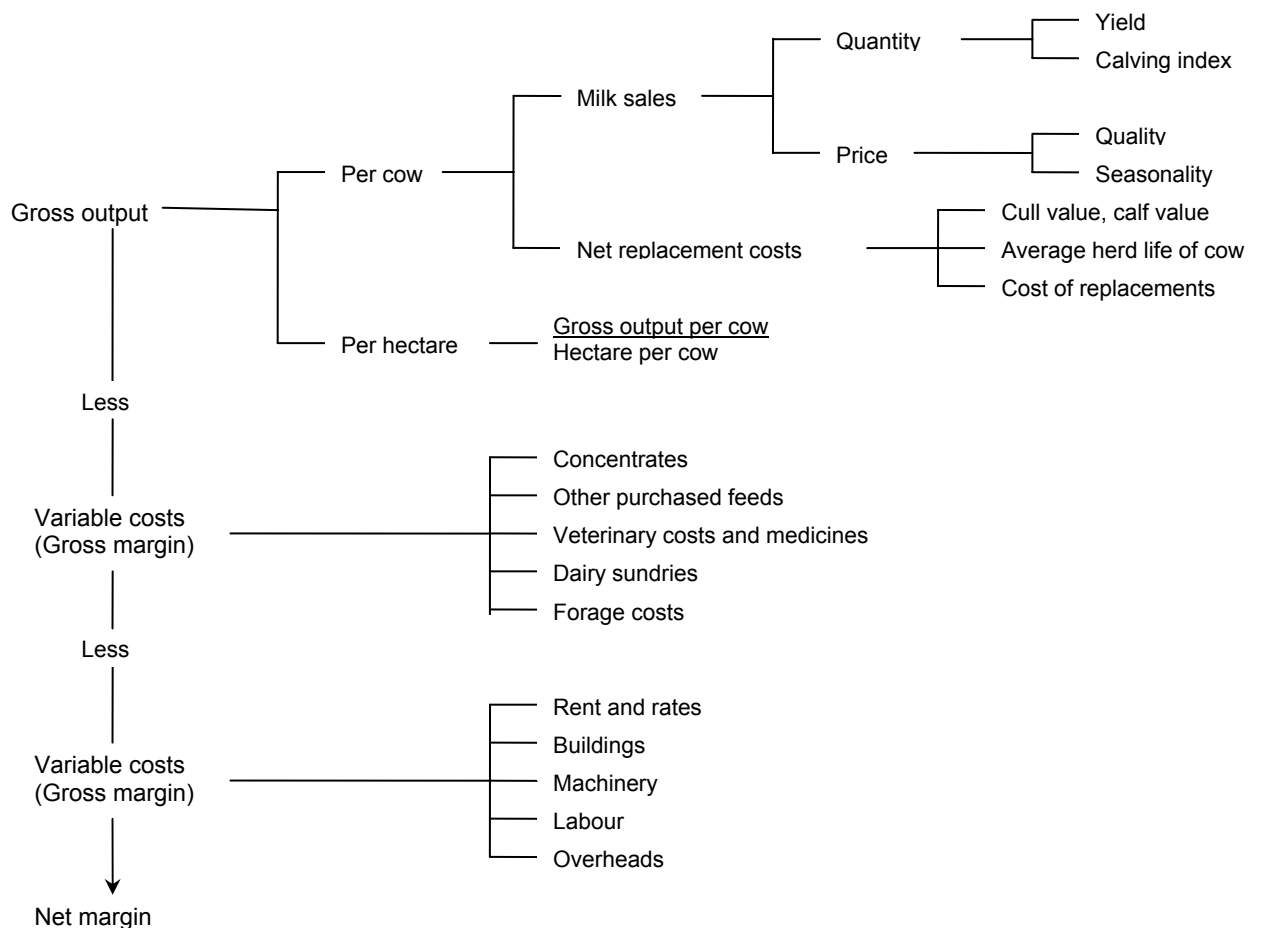
## ***2.2 Factors that Influence Farm Profitability***

Barry, *et al* (1988) noted that the process of measuring and monitoring of performance can facilitate financial control and maintain desired standards of performance. They describe the financial control process through the following steps:

- 1. Identifying goals:** The identification of performance criteria is the first step and of importance is their ordering and weights.
- 2. Developing measures for the goals:** This step involves the selection of indicators to measure goal attainment.
- 3. Determining norms for the measures:** The reality of goal attainment involves norms, targets or standards for the evaluation of a firm's performance. Some of these norms are elaborated on in Chapter 4 of this study.
- 4. Setting tolerance limits on norms:** With risk and uncertainty, a given in the agricultural environment, the various norms will seldom be exactly attained. Setting tolerance limits on deviations from the norms allows a manager reasonable variations before corrective actions are needed.

5. **Developing an information system:** Periodic reports keep the decision maker informed of the firm's progress and help to identify when corrective actions are needed.
6. **Identifying and implementing corrective actions:** When one or more of the performance measures or benchmarks exceed the tolerance limits for the respective norms, appropriate actions are needed.

Linking, the Norman and Coote (1971) model, which is identifying several factors affecting the profitability of milk production, with the profit equation is informative and explanatory. These factors are shown in Figure 2.1. It is important to note that all these factors are interrelated to each other and can not be evaluated without taking the rest into account.



Source: Norman, L., Coote, R. B. 1971.

**FIGURE 2.1: Factors affecting the profitability of milk production**

Shadbolt (2005:*op. cit.*) identified benchmarking as an important factor in the success of the control function. That is, once the key performance indicators (KPI's) have been identified and linked with the relevant benchmarks, management's ability is enhanced to compare both the own existing and target levels with other businesses and determine what best practices are available to enable the business to reach those targets. Management's important monitoring function is enriched with such comparisons and implementation and enables the remedial process.

Examples of KPI's and related measures are legio.

- In 1991, a US Farm Financial Standards Taskforce (FFSTF) presented 15 key performance measures to gain some standardisation in evaluating farm financial performance. The fundamental sources or documents utilised in the calculation of these measures were income statements, the balance sheets, and a statement of cash flow. The resulting measures include profitability, solvency, efficiency and repayment capacity of a farming business (Shadbolt, 2001:115)
- The Australian Dairy Research and Development Corporation (DRDC) have also developed a set of industry indicators for the Australian dairy industry (Cummings, 1999). They include four areas: profitability (economic), people, sustainability of natural resources and cash (financial) (Shadbolt, 2001:115).

Benchmarking is a process or activity that an organisation undertakes in order to improve productivity (McNamee, 1992). During the process of benchmarking the organisation identifies certain key performance indicators which are of importance in the quest for improved productivity. According to Shadbolt (2001:105), key performance indicators (KPI's) *relating to productivity* should have been identified during the planning process. Hanlon (1999: 3) defined key performance indicators as "specific gauges or measures used to monitor progress". These KPI's become milestones by which progress along the strategic path of the business are measured (Hanlon, 1999:3). A set of indicators is therefore required which measure both the short and long term

physical and economic health of the organisation. Shadbolt (2001:*op. cit.*) also stated that targets for these KPI's should appear in the goals set for the business. These include both financial and non-financial measures, and can be direct or indirect measures of productivity.

Some targets are results or outcomes that the business is aiming to achieve, while others targets involve factors or drivers that will enable management to achieve the defined outcomes (Shadbolt, 2001:105). If the defined KPI's are not at acceptable levels, it can signal management to plan and implement corrective steps. The timely use of KPI's will differentiate proactive managers from reactive managers.

### **2.3 Definition of Benchmarking**

According to Hanlon (1999:2) the best definition for benchmarking might be that of Professor Fred Hilmer: "Comparison of overall performance and key performance indicators with standards achieved by best practitioners worldwide".

Benchmarking is an important management tool enabling the comparison of actual financial and technical/physical data on a similar basis. Heady (1952) noted that if physical conditions are not optimal, then no economical or financial actions taken will be of value. It is therefore important to also benchmark the physical or technical conditions of a dairy farm. Typical critical factors will be described in Chapter 4.

Waterfield (2002) said benchmarking is the procedure of comparing the performance of an individual with the average of a comparable group in a comparable situation. Normally this is of a financial nature but it can be more wide ranging. For organic producers, for instance, cell counts and mastitis incidence are important and comparing these can be useful.

If properly used, benchmarking can become a powerful learning tool within an organisation (Hanlon, 1999:12). Benchmarking is a step in the ordering of data and ensuring the application and productive use of that information. It provides the opportunity to monitor progress with the identified key performance indicators (KPI's) and encourages development through interaction with peer group members (Bariball *et al*, 2005:389).

According to Roenfeldt (2004:44) each key performance indicator has two parts: 1) What you want to measure, and 2) What level of performance you anticipated. Key indicators are bits of information collected that managers need to know on a regular basis, which allow them to judge if and where problems may be occurring.

McNamee (1992) identified four different types of benchmarking, namely:

1. **Industry group measurements:** This is the measurement of various facets of one's operation and comparing these to similar measurements of the industry.
2. **"Best practice" studies:** These are studies of "what works best". It is normally not useful as metrics because what works best for one entity, might not work at all for another, due to differences in various factors. Yet it can be useful as stimulators.
3. **Cooperative benchmarking:** This is if two or more competitors co-operatively measure key production functions of inputs, outputs and outcomes with the aim of improving them. Cooperative benchmarking is done with the assistance of the entity being studied.
4. **Competitive benchmarking:** This type of benchmarking is the study and measurement of a competitor without its cooperation and with the aim to improve one's own critical success factors. An example is where a third party consultant studies a group of members or competitors and share the results with all, but he/she is the only one who knows which data belong to which entity.



Hanlon (1999) indicated that benchmarking is definitely not one of the following:

- Number comparison. Numbers alone cannot implement change.
- Business tourism. Visits to other businesses or farms are an essential part of benchmarking, but those who are inquiring and responsible for implementing change must do the visiting.
- Just competitive analysis. Benchmarking enables the organisation to pick the “best of the best” and therefore leapfrog the competition by synthesising good ideas from several sources.

Benchmarking is a process of measuring your own operations against similar operations for the purpose of improving your business process (McNamee, 1992).

Dominick Salvatore (2001:66) stated that “benchmarking refers to the finding out, in an open and aboveboard way, how other firms may be doing something better (cheaper) so that your firm can copy and possibly improve on this technique.”

According to Smith (1996) benchmarking is a way to identify problems and opportunities for improving performance. Using objective measurements of performance assists in focussing attention on important problems. Benchmarking therefore provides the roadmap to competitive excellence. Smith said in his article that benchmarking helps identify components of the business that are supporting ongoing success. Questioning functions within a business means focussing on how the task is performed and means asking: “Are we doing the right thing?” (*Effectiveness*), while examining processes triggers a concern with, “Are we doing things right?” (*Efficiency*). Benchmarking normally targets those processes that are constraining the business or use excessive resources, without adding value.

A World Wide Web search of the definition of benchmarking gave the following results:

- A process of comparing your organisation's practices to the best practices or standards of other similar organisations ([www.hrvs.ca/glossary\\_e.cfm](http://www.hrvs.ca/glossary_e.cfm)).
- The process of comparing a firm's performance against the practices of other leading companies – in or outside an industry – for the purpose of improving performance. Companies also benchmark internally by tracking and comparing past performance ([www.csxworldterminals.com/resources/Glossary.asp](http://www.csxworldterminals.com/resources/Glossary.asp)).
- Benchmarking (also “best practice benchmarking” or “process benchmarking”) is a process used in management and particularly in strategic management, in which companies evaluate various aspects of their business processes in relation to best practice, usually within their own industry. This allows companies to develop plans on how to adopt such best practice. Benchmarking may be a one-off event, but is often treated as a continuous process in which companies continually seek to challenge their practices (<http://en.wikipedia.org/wiki/Benchmarking>)

Furthermore, the difference between benchmarking and benchmarks must be clear. Camp (1995:18) describes benchmarking as a process or activity and benchmarks as industry standards. There are several generic definitions of benchmarking, which were already given. Benchmarks may be descriptive and converted to a performance measurement that shows the effect of adopting a certain practice. Choosing the appropriate benchmark requires some thinking, since the chosen benchmark will become an important management tool. According to Bailey (1992) good benchmarks can increase the proficiency or performance evaluation and highlight the contributions of good managers, but bad benchmarks obscure the contributions of managers and can lead to inefficient allocations of resources. Ansell *et al* (2003) summarized Bailey's guidance on benchmarks. Benchmarks or norms should be:

- Unambiguous. The components of the benchmark need to be clearly described.
- Investable. It should be open to managers or users for active management.
- Measurable.

- Appropriate.
- Understandable and adjustable.

Benchmarking is a continuous process, using best performing businesses to identify best practices so as to become a best performing business in one's own business.

## ***2.4 Methodology of Benchmarking***

There are many versions of benchmarking steps used by different organisations. McNamee (1992) noted that all models use the same steps but the difference between them is that some of the steps are divided into multiple steps. The simplest framework, as recommended by McNamee (1992), has six steps:

1. **Plan:** The kinds of measurements chosen have to be useful to compare performance with a benchmark partner.
2. **Research:** The purpose is to establish which measurements to use, to identify a benchmark candidate and to collect public data.
3. **Observe:** Observe the benchmarking partner, and visit if possible.
4. **Analyse:** A part of the analysing process is to step back and look for the things that numbers can not tell you. Also be alert to qualitative data and other observations.
5. **Adapt:** The purpose of benchmarking is to improve operations; without adapting this will not be possible.
6. **Improve:** It is not enough to improve if competitors are improving at a faster rate. Benchmarking inspires an organisation with a sense of continuous improvement, and also serves as practical monitor to ensure long-term survival of the organisation.

According to Waterfield (2002) benchmarking is part of the management process and is most appropriate when used regularly to compare the performance of a business against a sample of other businesses. He identified three stages in the benchmarking process:

1. Collection of detailed information,
2. Comparison of the information in a standard form,
3. Open discussion of the results.

Gerber and Franks (2001) noted that current best practice recommends the comparison of performance against industry standards. The latter is averages derived from pooling similar farms. One consequence of this is the need to ensure that similar methodologies are used for the target and the average farm. They also noted that in certain circumstances the average farm is little more than a notional farm that does not or could not exist in practice.

Efficiency is an important concept for a farmer since it measures the use of resources in production (Gerber and Franks, 2001). Efficiency is measured as the value of a ratio between a product (output) and a resource (input). This poses two problems. The first problem is to decide which inputs and outputs must be used to calculate the ratio of efficiency, and secondly the interpretation of the resulting value.

The success of benchmarking is dependent on identifying, monitoring and controlling the correct set of performance indicators (Smith, 1996).

## ***2.5 Benefits of and Problems with Benchmarking***

Benchmarking is only useful when it leads to improving competitive performance. Applying it successfully means treating it as a continuous process and focusing wherever best practices can be found, even if it is found outside the firm's own industry.

Through encouragement to measure and monitor performance, it is anticipated that the participating farmer will improve competitiveness, enhance financial sustainability and the likelihood of achieving his/her long-term strategic objectives (Bariball *et al*, 2005:394)

Camp (1989) and Shadbolt (2001:106) suggest that the benchmarks are utilised to identify a performance gap and best practices are used to identify ways to close this gap.

The evaluation of financial performance is essential for the successful management of any farm or agribusiness (Boehlje, 1994), and according to Shadbolt (2001:108) businesses must utilise gauges or measures to monitor progress.

Waterfield (2002) also identified a few problem areas associated with benchmarking:

1. Producers are not used to sharing financial information, although there is more interest in the costs of production rather than profits.
2. Producers do not record information in sufficient detail for meaningful comparison.
3. Even where information is recorded there is a lack of willingness to be open about the problems in the business.
4. On all farms the division of overhead costs between enterprises is difficult, particularly machinery and labour costs.

According to Camp (1995) the purpose of benchmarking is to break the paradigm of not being able to learn from others. The purpose is to:

- Analyse the operation to assess the strengths and weaknesses of the current process and find ways to reduce errors.
- Know the competition and industry leaders. When one does benchmarking, one must find out who are the best of the best.
- Incorporate the best of the best. Anyone who does benchmarking must learn from the leaders about their superior practices and then emulate the best practices.
- Gain superiority. After the incorporation of the best of the best the benchmarking firm must become the new benchmark.

## **2.6 The Nominal Group Technique**

For this study the Nominal Group Technique (NGT) is chosen to identify the benchmarks or norms for the dairy farmer in the Highveld region of South Africa.

Robbins (2001:634) defined the NGT as “A group decision-making method in which individual members meet face-to-face to pool their judgements in a systematic but independent fashion.” According to Potter, *et al* (2004), the NGT is an approach that was first described in the 1960’s as a procedure to facilitate effective group decision-making in psychological research. According to Dunham (1998) the NGT is used when concerned with judgemental decision-making where creative solutions are sought, and the resulting ideas are likely to be better than those that might be obtained by other methods. The three most typical applications have been problem identification, development of solutions and establishing priorities. Potter, *et al* (2004), stated that the purpose of the NGT is to generate information in response to an issue that can be prioritised through a group discussion. Normally between five and nine participants take part in a highly structured face-to-face discussion.

Lang (1995:2) mentioned that Delphi is the name given to a set of procedures for eliciting and refining the opinions of a group – usually a panel of experts. It relies on the informed intuitive opinions of experts. The conventional Delphi technique has two main functions, which is forecasting and estimating unknown parameters (Lang, 1995). The NGT is therefore a derivative of the Delphi technique.

The Nominal Group Technique has a number of advantages over other group processes, when compared using the attributes in Table 2.1.

**TABLE 2.1: A comparison of group decision-making processes**

<b>Attribute</b>	<b>Decision-making process</b>			
	<i>Delphi</i>	<i>Focus groups</i>	<i>Brain-storming</i>	<i>NGT</i>
Face-to face group meeting process	No	Yes	Yes	Yes
Generates a large number of ideas	Yes	Maybe	Maybe	Yes
Avoids focusing on a single train of thought	Yes	Yes	No	Yes
Encourages equal input from all participants	Yes	No	No	Yes
Highly structured process	Yes	Maybe	No	Yes
Meeting time usually 1-2 hours duration	No	Yes	Yes	Yes
Avoids “quick” decision-making	Yes	No	No	Yes
High degree of task completion	Yes	Maybe	No	Yes
Provision of immediate feedback	No	Maybe	Maybe	Yes
Measures relative importance of ideas generated	Yes	No	No	Yes

Source: Potter, *et al*, 2004.

There are also a number of other characteristics of the NGT that make it an efficient and constructive research method. Minimal pre-meeting preparation is required by the participants and they are limited to a single meeting of up to two hours. Task completion promotes satisfaction and researcher-bias is minimised due to the highly structured process.

### **2.6.1 The Nominal Group Technique Protocol**

Potter, *et al* (2004), noted that the NGT involves five stages or protocol, namely:

1. **Introduction and explanation:** The purpose and procedure of the meeting is explained to the participants.
2. **Silent generation of ideas:** During this stage each participant can identify his/her own ideas, and should not discuss it with fellow participants.
3. **Sharing ideas:** The participants now share their ideas with the meeting and the facilitator record each idea, but there is no debate about ideas aired. This round robin process continues until all ideas have been presented.
4. **Group discussion:** The ideas are now debated and further details can be given to clear up any misunderstandings. This process must be as neutral as possible.

5. **Voting and ranking:** This stage involves the prioritisation of the recorded ideas in relation to the original question.

Adherence to the NGT protocol will ensure that researchers collect a wealth of valuable information that accurately reflects participants' thoughts (Potter, *et al*, 2004:127). Since the participants are directly involved in both data collection and analysis, researcher-bias is restricted to the minimum.

Potter, *et al* (2004), also noted that there are some issues to consider when using the NGT in a research project:

- The questions given to the group must be stimulating and clear, in order for the participants to make a meaningful contribution.
- The participants should qualify for selection, based on their expertise of the matter under discussion.
- The facilitator must be an expert on the topic under discussion, or a credible non-expert. He/she must also be familiar and comfortable with the NGT process.
- The researcher must have a clear understanding of the issue(s) that he/she wanted to explore and also understand the limitations of the NGT.
- Data collection occurs with the information that is recorded during the meeting.

### **2.6.2 Benefits and Limitations of the Nominal Group Technique**

Dunham (1998) noted that the NGT has the following benefits over other group techniques:

1. Balances participation across members.
2. Balances influence of individuals.
3. Produces more creative ideas than other interacting groups.
4. Results in greater number of ideas than traditional interacting groups.
5. Results in greater satisfaction for participants.
6. Reduces the conforming influence common to most face-to-face meetings.



7. Encourages participants to confront issues on a problem-solving basis rather than on a personal assault basis.
8. Leads to greater sense of closure and accomplishment.

The NGT also has some limitations, which are described by Dunham (1998):

1. It requires extended advance preparation by the facilitator.
2. Tends to be limited to a single purpose.
3. Needs agreement from all participants to use the same structured method, which some people might resist.

### **2.6.3 Members of the Nominal Group**

The following experts were used in the Nominal Group:

1. Prof Dirk Lourens (Herd Health): Section head of the Herd Health Section at the Faculty of Veterinary Science of the University of Pretoria at Onderstepoort.
2. Prof Lourens Erasmus (Feeding): Associate professor in dairy feeding and management at the Department of Animal and Wildlife Science of the University of Pretoria
3. Dr Koos Coetzee (Economics): Manager Economical and Statistical services of the Milk Producers' Organisation.
4. Dr Nico Schutte (Reproduction and genetics): Director of the MPO/Intervet Institute of Dairy Technology and previous general manager of Taurus.
5. Mr Mike van den Berg (General): Dairy farmer in the North West Province and chairman of MPO North.
6. Mr Jas Wasserman (General): Well-known and awarded dairy farmer (retired), currently involved in training with the MPO/Intervet Institute of Dairy Technology.
7. Mr Johan Wasserman (General): Dairy herd manager in Dubai.

## **2.7 Summary**

Benchmarking as it is currently known, can be accredited to the Xerox Company, who sought to reduce costs and improve profitability. Since then benchmarking was adopted by a large number of companies from various industries, in order to find the best practice in their own industry or to become the benchmark company.

Various definitions exist for benchmarking, but the essence of all of them is that benchmarking is a continuous process of comparison against companies or organisations in order to improve profitability and to adopt best practices.

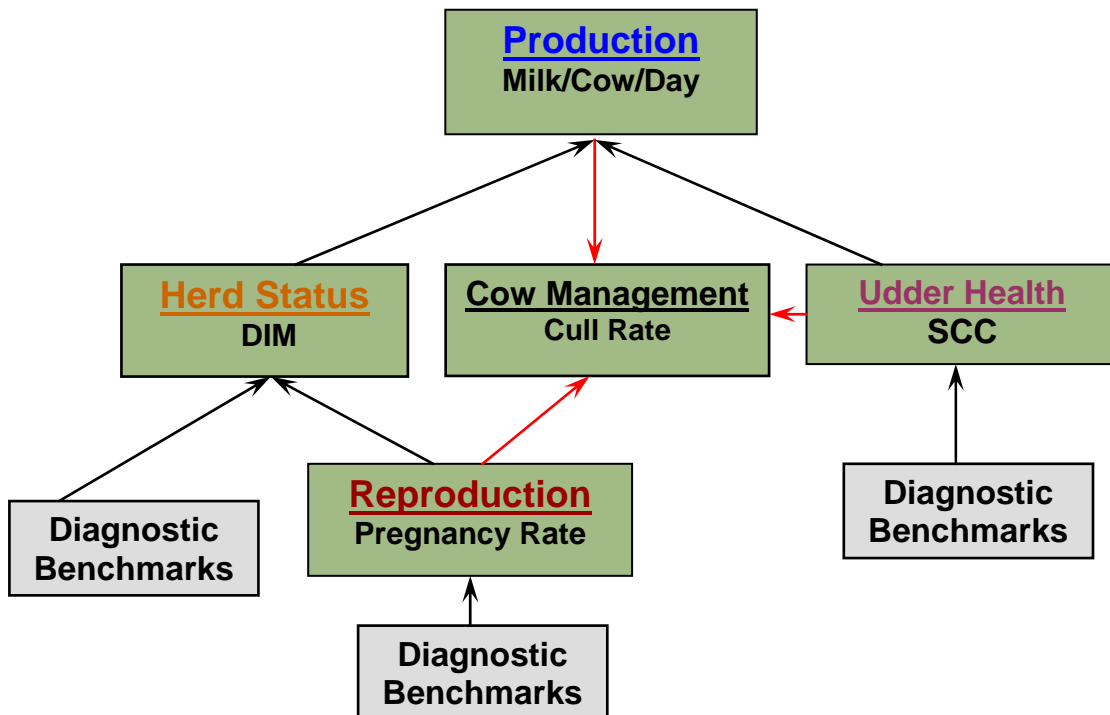
As mentioned, benchmarking is a process, which includes in general, six steps, namely: Planning, research, observation, analysis, adaptation and improvement.

Although benchmarking can be used to find and implement best practices and therefore improve profitability, there are also a few problems with the process of benchmarking. Some of them include the availability and accuracy of dairy production information and the willingness to adapt. In order to use a benchmark it must comply with certain criteria; it must be unambiguous, investable, measurable, appropriate and understandable and adjustable.

## CHAPTER 3: BENCHMARKING NORMS FOR THE INTENSIVE DAIRY PRODUCER

### 3.1 Introduction

As mentioned in the Chapter 2.6, the Nominal Group Technique was chosen to identify the benchmarking norms. During the group discussion and further discussions with other knowledgeable people, many different norms were identified that can be used in the benchmarking process of a dairy farm. But not all of these norms are critical in the success of a dairy farm, although all of them play a role in the results of the total business. It is also important to note that all the factors or norms that were identified, are actually linked to each other. It is therefore important to look at the dairy farm from a holistic view when evaluating it. Figure 3.1 gives an example of the relationship between certain benchmarks or parameters in the dairy herd.



Source: Hilty and Hyde, 2001

**FIGURE 3.1: An example of the relationship between certain benchmarks**

As previously mentioned, production factors are linked to each other. Norman and Coote (1971) identified different factors affecting the profitability of milk production, which is shown in Figure 2.1. All these factors are interrelated and all of them are important for the success of dairy production. In this part of the study the critical success factors that were identified during the Nominal Group session will be listed and defined. Where possible a standard will be given, which can be used as a benchmark when evaluating the dairy enterprise. The factors are divided into five main areas, namely: herd health, feeding, reproduction, economical factors and other factors.

Assessing the performance of a farming operation against other equivalent businesses is a good way to identify strengths and weaknesses within the own business, but the trick is to ensure that the comparisons are meaningful. The number of norms that can be used in a comparison is endless, but choosing the wrong norm can be more damaging than helpful.

Smith (1996) said “the need for information systems that monitor and control the performance of a dairy business has probably never been greater and more crucial to the long-term viability of dairy businesses than it is today.” His statement is still relevant in 2007 and change for change’s sake is not the objective; change that enhances the value of the farm business for all its stakeholders is (Smith, 1996).

### ***3.2 Benchmarking Norms – Herd Health and Reproduction***

Herd health and reproductive efficiency can be evaluated in various ways, but it is important to note that all these factors must be seen as interrelated, which means that an evaluation of herd health can not be done by looking at one benchmark alone. Smith (1994) indicated that a lack of accurate reproductive records can result in hidden costs such as fewer calves, lower conception rates, longer lactations and dry periods and ultimately a loss in milk production.

Herd health can be subdivided into three main areas: fertility performance, udder health and general herd health.

### 3.2.1 Fertility Performance

Fertility performance can be used as an indicator of optimal herd management. It can be evaluated by using primary indexes and diagnostic indexes.

#### 3.2.2.1 Primary Indices

**a. Herd structure:** The structure of a herd is defined as the number of lactating cows, dry cows, heifers and calves that a dairy herd consists of. In general the herd must consist of 80% lactating animals and 20% non-lactating animals. This standard is flexible and will change if there is, for example, a change in the milk price or the quantity of roughage, but these changes should not be taken lightly. A herd structure that is not balanced can have negative effects. A herd with too many dry cows will have a negative impact on milk production and is normally an indication of reproduction problems. With an increase in milk prices, farmers tend to have more cows-in-milk to benefit from the higher production capacity. The optimal herd structure for a 100 lactating cow herd is given in Table 3.1.

Within the herd structure a number of indicators can be identified to use for evaluation purposes.

- *Cow herd vs. Heifer herd:* The standard is a 50:50 ratio of cows to heifers.
- *Lactating cows vs. Dry cows:* A ratio of 83:17 is a standard norm for lactating and dry cows in a herd.
- *Lactation distribution:* A norm of a third for each lactation stage is set. Therefore there must be  $\frac{1}{3}$  early lactation animals,  $\frac{1}{3}$  mid-lactation animals and  $\frac{1}{3}$  late-lactation in an ideal herd structure.
- *Days-in-milk:* The days-in-milk is directly related to the dry period and is a good indicator of reproductive efficiency and herd management (Smith, 1994). The 12-month average for days-in-milk should be 160-

165 days. Smith (1994) noted that an average of more than 200 days-in-milk is an indication of a reproductive problem.

- *Age distribution:* In an ideal herd the norms for age distribution are as follows: 25% 1<sup>st</sup> lactation animals, 60% 2<sup>nd</sup> to 5<sup>th</sup> lactation animals and 15% animals older than 5<sup>th</sup> lactation. Longevity also impact on the age distribution of the dairy herd. The aim is to have the average number of lactations greater than three. Average longevity, measured as the average parity (or the number of lactations), for South African dairy herds is less than three lactations (Hallowell, 2006:8). It is important to note that the age distribution will decline in herds that are busy expanding.

**TABLE 3.1: Optimal herd structure for a 100 lactating cow herd**

	<b>Optimal per 100 lactating cows</b>
Lactating cows: 1-100 days	23
Lactating cows: 101-200 days	23
Lactating cows: 201-300 days and more	28
Lactating heifers: 1-100 days	8
Lactating heifers: 101-200 days	8
Lactating heifers: 201-300 days and more	10
Dry cows: 3 weeks before calving	6
Dry cows	12
Heifers: 3 weeks before calving	5
Heifers: Pregnant	30
Heifers: +12 months, not pregnant	12
Heifers: 6-12 months	24
Heifers: 2-6 months	16
Heifers: 1 day - 2 months	5
<b>TOTAL</b>	<b>210</b>
<b>Cows-in-lactation</b>	<b>100</b>

Source: Wasserman, J. (2005)

Erasmus (annon) indicated the number of heifers needed to keep the cow herd at 100 (Table 3.2). From Table 3.2 it is clear that as the age at first calving declines the number of heifers that must be maintained on the farm drops dramatically. If the culling rate for example is 20%, then seven less heifers needed to be maintained if the age at first calving is reduced from 28 months to 24 months. This will in turn result in less feed costs and increased milk production and revenue.

**TABLE 3.2: Heifers needed to keep cow herd at 100**

Cull rate (%)	Age at first calving (months)							
	22	24	26	28	30	32	34	36
	<b>No of Heifers</b>							
20	40	44	48	51	55	59	62	66
24	48	53	57	62	66	70	75	79
28	56	62	67	72	77	82	87	92
30	61	66	72	77	82	88	94	99
34	69	75	81	87	94	100	106	112

Source: Erasmus (anon)

- b. *Inter-calf period:*** The inter-calf period is defined as the period between two consecutive calvings, and is affected by the days open (the number of days that the cow is not certified as pregnant) and the gestation length (Smith, 1994). The goal for an ideal inter-calf period, as identified by the Nominal Group members, is less than 400 days. It is also ideal to aim for less than 10% of cows in a herd with an inter-calf period of more than 400 days. The current average inter-calf period for South African dairy cows is 419 days (ARC, 2006). The inter-calf period is also dependable on the level of production. In high producing herds the inter-calf period can rise to 420 days.
- c. *Days calving to first insemination:*** This norm can be defined as the number of days between calving and the first insemination. The average or norm is 65-75 days over the total herd (cows and heifers). It is important to have less than 15% cows inseminated after more than 100 days, therefore more than 85% of the cows in the herd have to be inseminated in less than 100 days.
- d. *Calving to conception:*** This norm can be defined as the number of days between calving and conception of certified pregnant animals. The average obtained from the Nominal Group is between 85 and 115 days.
- e. *Days open:*** Days open is defined as the number of days that a cow is open, therefore not certified as pregnant. The aim is to keep the number of days open at less than 130. This norm may be the best indicator of reproductive efficiency (Smith, 1994). It is important to have less than 10%

cows not pregnant after 150 days, or 90% certified as pregnant. According to Smith (1994) days open is influenced by factors such as length of the voluntary waiting period, heat detection accuracy, semen quality, nutrition, cow fertility, disease and weather. The members of the Nominal Group confirmed these and mentioned that the days open is a good way to identify problem cows.

- f. **Lactation length:** The lactation length is the number of days-in-milk. According to the Nominal Group the current average lactation length is 305 days, but it can be longer in high producing herds.
- g. **Dry period length:** The Department of Animal Science at the Macdonald Campus of the McGill University mentioned that the dry period is a critical period for the health, production and reproduction of the dairy cow. The Nominal Group noted an average dry period of 55 days, with a variance of 42-60 days. Smith (1994) noted that exceptionally long or short dry periods will adversely affect profitability of cows, since a short dry period will not provide adequate rest, and longer dry periods will result in higher feed costs. Overton (2005:25) mentioned that recent studies suggest that dry periods can be shortened to 30-40 days, without effect on subsequent production. Management of multiparous (second or greater lactations) cows that merits continued milking down to a target of 40-days dry, translates into substantial economic benefit and enables farmers to move toward simpler strategies for nutritional management of dry cows.
- h. **Culling rates:** The Nominal Group noted the following culling rates:
  - o *Crude culling:* It is culling for selection or any other reasons. This type of culling rate should be less than 25%.
  - o *Forced culling:* Culling due to health or reproductive problems should be less than 10%. It is important to keep record of the specific reason for the forced culling, such as udder problems, feet problems, fertility or health reason, etc.



### **3.2.1.2 Diagnostic indices**

The second type of indexes used to evaluate fertility performance is diagnostic indexes. The most important diagnostic indexes identified for the cow herd (excluding heifers) by the Nominal Group of experts are:

#### **a. Conception parameters:**

- *Artificial insemination (AI) conception rate:* The AI conception rate must be greater than 55% for the cow herd. Conception rate influences days open because if a cow does not conceive, she will be open for an additional oestrous cycle, which is 21 days. Nebel (2002) noted that four general categories determine the outcome of conception per insemination, which is affected by:
  - Female fertility: It is determined by the condition of the reproductive tract, nutritional status, and changes in body condition from calving to insemination, age and breed.
  - Male fertility: This can not be controlled by the herdsman
  - Environmental factors: Influenced by heat stress
  - AI techniques: Accuracy of heat detection, timing of insemination, semen handling and placement in the reproductive tract are all important success factors.
- *Average services per conception:* The average inseminations to conception, calculated for pregnant cows only, should be at least two.
- *Other indicators:* Two other conception parameters that can be used are the conception average for all AI's done, that should be 50%, and the percentage cows more than 150 days-in-milk but which are not pregnant, should be less than 15%.

#### **b. Efficiency of oestrus detection:**

It is important to note that the above-mentioned conception parameters are closely related to the efficiency of heat detection.

- *Calving to first insemination:* According to Smith (1994) most cows show their first oestrus 30-50 days after calving. Producers whose herds have good conception rates should set 65-70 days as their average goal.

- *Cows inseminated at 100 days-in-milk:* The members of the Nominal Group noted that more than 80% of the cows which are 100 days-in-milk should have been inseminated.
- *Ratio of normal intervals to double intervals:* A normal interval is defined as most of the heats when the cow did not conceive at the previous insemination. A normal interval is between 18-25 days. A double interval is explained as one unobserved heat and ranges between 36-50 days (Zeron, 2006). The ideal ratio set by the Nominal Group for normal to double intervals is 6:1.
- *Service return intervals:* The Nominal Group of experts noted that more than 65% of intervals should be normal intervals (18-25 days).

**c. Routine pregnancy examinations**

The herd health parameters and their values, as identified by the Nominal Group, which must be taken into account when a herdsman or producer do routine pregnancy examinations, is summarised in Table 3.3.

**TABLE 3.3: Herd health parameters at pregnancy examination**

<b>Parameter</b>	<b>Norm</b>
Selected cows	> 85% pregnant
Abortions	< 2%
Retained placentas	< 5% per annum
“Dirty” cows (i.e. infections, endometritis, etc)	<10% (15% in summer)
Birth difficulties (dystocia)	< 5%

Metabolic disorder benchmarks can also provide the herdsman and animal nutritionist with information to consider if a feeding problem exists. The above parameters have enormous economical consequences because it affects milk production, reproduction, premature culling and treatment costs (Shaver, 2000). It is also important to note that there is close relationships between milk fever, ketosis and displaced abomasums (LDA).

As mentioned earlier, the above indexes are benchmarks for the cow herd. The benchmarks for the heifers (replacement rearing) differ somewhat from these figures. The indexes for heifers are summarised in Table 3.4.

**TABLE 3.4: Performance indices for heifers**

<b>Primary indices</b>	<b>Norm</b>
Age at first calving	≤ 24 months
Body weight post calving	± 80% of mature mass
Condition score of heifers at calving	3
% Mortality (total rearing period)	< 10%
% Abortions in heifers	< 4%
<b>Secondary indices</b>	
% Mortality	
0 - 24 hours	< 5%
1 - 60 days	< 3%
2 - 24 months	< 1%
% Morbidity (prevalence/group)	
% Diarrhoea	< 20%
% Clinical respiratory disease	< 6%
% Clinical lameness	< 5%
% Clinical mastitis at calving	< 5%
Reproductive performance	
Age at conception	≤ 15 months
Body weight at breeding	± 66% of mature mass
Heat detection rate	> 80%
% pregnant first insemination	70%
No inseminations/pregnancy	1.3
Incidence of dystocia in heifers	< 5%
Culling (fertility reasons)	< 5%

Source: Prof D Lourens, University of Pretoria (Member of Nominal Group)

### 3.2.2 Udder Health and Mastitis

Two types of mastitis can be identified and is defined by the International Dairy Foundation (*IDF Bulletin 394/2005: 4*) as:

- *Clinical mastitis*: Udder inflammation characterised by visible abnormalities in the milk and/or the udder. Severity of clinical cases should be described as mild, moderate or severe.
- *Sub-clinical mastitis*: Inflammation of the mammary gland that is not visible and requires a diagnostic test for detection. The most used diagnostic test is the milk somatic cell count. Sub-clinical mastitis is the most prevalent form of the disease.

Poor udder health and mastitis is one of the most costly conditions in Britain's national dairy herds and is the reason for the culling of 27% of dairy cows annually (NAHMS 2002 *Dairy Report*). Giesecke, *et al* (1994) noted that mastitis is generally the most underestimated single disease affecting dairy cattle. Farmers readily understand the loss if a cow dies due to severe mastitis, however the daily financial loss from sub-clinical mastitis are usually over-looked. The range of losses, as identified by Giesecke, *et al*, and also documented in the *International Dairy Federation Bulletin 394/2005*, caused by mastitis is indicated in Table 3.5.

The somatic cell count (SCC) in milk is a very sensitive indicator of udder health (Giesecke, *et al*. 1994:111). An increased SCC value is an indicator of udder health management problems, udder diseases, decreased milk production and quality and most importantly, increased production costs and less profits. Giesecke, *et al* (1994) mentioned that the SCC in herd milk is the most practical way available to monitor the efficacy of mastitis prevention and control, and the SCC value is of importance to dairy farmers, milk buyers and veterinarians. The monthly determination of the SCC in herd milk facilitates the monitoring of the herd's udder health management. Giesecke, *et al* (1994:111) quoted the normal somatic cell count in milk to fluctuate around 100 000 cells per ml of milk. Table 3.6 summarises the key for determining the udder health of a dairy herd depending on the SCC values per ml of herd milk

(bulk tank samples), as given by Giesecke, *et al* (1994). These values were also identified by the Nominal Group to use as primary indices when evaluating udder health in dairy herds.

**TABLE 3.5: Range of losses due to mastitis**

<ol style="list-style-type: none"><li>1. Cost of curative and preventive treatments:<ul style="list-style-type: none"><li>▪ Remedies and disinfectants</li><li>▪ Discarded milk not fit for human consumption</li><li>▪ Veterinary consultation</li><li>▪ Extra labour</li></ul></li><li>2. Decreased milk yield<ul style="list-style-type: none"><li>▪ Temporary</li><li>▪ Permanent</li></ul></li><li>3. Loss of potential lactations</li><li>4. Loss of dairy cows and wastage of replacements due to:<ul style="list-style-type: none"><li>▪ Disposal of cows and heifers unproductive from mastitis</li><li>▪ Disposal of animals with chronic mastitis</li><li>▪ Emergency disposal or death</li></ul></li><li>5. Feeding animals unproductive due to mastitis</li><li>6. Expenses and effort of breeding, rearing and replacing animals affected with mastitis</li><li>7. Loss of revenue from sales of low grade milk where milk is paid on quality</li></ol>
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Source: Giesecke, *et al* (1994)

**TABLE 3.6: Key for determining the udder health of dairy herds depending on the SCC values of herd milk**

SCC per ml herd milk	Classification of udder health situation in herd	Commenting on the udder health situation in herd
< 125 000	Very Good	Udder diseases as a herd problem not recognisable; mastitis control probably effective
125 000 - 250 000	Good	
250 000 - 350 000	Satisfactory to Moderate	Cows with udder disease are present
350 000 - 500 000	Doubtful to unsatisfactory	Udder health is a herd risk; increased numbers of cows with udder diseases present; veterinary mastitis control necessary
500 000 - 750 000	Unsatisfactory	Herd has distinct udder health problems affecting many cows; veterinary mastitis control urgently required
> 750 000	Inadequate to very serious	Herd with serious udder health problems affecting most of the cows; veterinary mastitis control compulsory

Source: Giesecke, *et al* (1994:114)

A number of other benchmarks were identified by the Nominal Group to use in evaluating udder health and the incidence of mastitis:

- *Clinical mastitis*: Incidence per month should be less than 2%.
- *Culling rate due to mastitis*: Culling should be less than 5%.
- *High SCC*: Less than 10% of cows must have a high SCC (> 25 000 on cow level, or > 400 000 on udder quarter level).
- *Low SCC*: The aim is to have more than 85% of cows with a low SCC (< 25 000 on cow level).

### 3.2.3 General Herd Health

The Nominal Group mentioned under the topic of general herd health that it is important to keep herds totally free of the following diseases, since they have major negative effects on production, can cause severe illness and death, and can also be transmitted to humans (zoonotic diseases) (Olivier, 2002):

- *Bovine Tuberculosis (TB)*.
- *Bovine Contagious Abortions (CA)*. Both TB and CA are controlled diseases, which mean they must be reported to government veterinary services.
- *Bovine Virus Diarrhoea (BVD)*

The group of experts also identified some benchmarks for other herd health parameters for the cow herd, which are shown in Table 3.7.

**TABLE 3.7: General herd health benchmarks**

Parameter	Norm
Milk fever	< 3%
Ketosis	< 5-10%
Displaced abomasums (LDA)	< 2%
Lameness	< 5-10% per annum

Source: Prof D Lourens, University of Pretoria (Member of Nominal Group)

Another benchmark that can be used in the evaluation of general herd health is locomotion scoring. A locomotion score is a qualitative index of a cow's ability to walk normally. The score is done visually according to a scale of 1 to 5, where 1 reflects a cow that walks normally and 5 reflects a cow that is three-legged lame (Robinson, 2001). Refer to Table 3.8 for a locomotion scoring guide.

**TABLE 3.8: Locomotion scoring guide**

Score	Description	Back	Assessment
1	Normal	Flat	Cow stands and walk with a level back. Gait is normal
2	Mildly lame	Flat or arch	Cow stands, back level , but develops an arched back to walk. Normal gait.
3	Moderately lame	Arch	Arched back is evident while standing and walking. Gait is short strides.
4	Lame	Arch	Arched back is always evident and gait is one deliberate step at a time. Cow favours one or more legs/feet
5	Severely	3-legged	Cow demonstrates an inability or extreme reluctance to bear weight on one or more limbs/feet.

Source: Robinson (2001) from Sprecher *et al* (1997)

Locomotion scoring can be used to assess the expected reduction in dry matter intake and loss in milk yield due to lameness. Lameness costs the producer lost milk and revenue, but also results in costs to rectify the lameness problem.

### **3.3 Benchmarking Norms – Nutrition and Feeding**

#### **3.3.1 Dry Matter Intake**

Dry matter intake (DMI) is the first limiting factor in most dairy rations and the key factor to increase energy (NRC, 2001:21). Dry matter intake is based on body weight and the level of milk production, with milk production the more important factor (NRC, 2001). Hutjens (anon) noted that milk production increases by two kilograms, for each kilogram of additional dry matter intake above current intake. One must remember that the DMI in early lactation of first lactation cows will be significantly lower than in mature cows (Hutjens, 2003:75). The time to reach peak DMI can take five to ten weeks longer than the time to reach peak milk yield.



The NRC (2001:21) gives the following formulae for the calculation of optimal dry matter intake:

Milk cows:	$DMI = (0,018 \times \text{body weight}) + (\text{kg } 4\% \text{ FCM} \times 0,305)$
Dry cows:	$DMI = 0,018 \times \text{body weight}$
	Where $4\% \text{ FCM} = (\text{kg milk} \times 0,4) + (\text{kg fat} \times 15)$
	Where: FCM = fat corrected milk

Table 3.9 gives estimated dry matter intake for cows according to body weight and milk production. As mentioned the DMI of heifers will be significantly lower than the DMI of mature cows. Table 3.10 shows a comparison of the intake of a 546 kg heifer and 636 kg mature cow.

A rule of thumb given by the Nominal Group is that an animal should eat 3-4% DMI of its body weight. If any significant deviation from this occurs, the help of an animal nutritionist is necessary.

**TABLE 3.9: Estimated dry matter intake: Milk cows – kg DM/cow/day**

Milk Yield (kg)	Body weight (kg)			
	400	500	600	700
4% Fat Corrected Milk				
20	14.6	15,9	17,3	18,2
30	17.7	19,6	20,9	22,3
40	21.8	23,2	24,1	25,0
50	NA	26,8	28,2	28,6
60	NA	NA	32,3	33,6

Source: NRC (2001:23)

**TABLE 3.10: Dry matter intake (DMI)**

Week	First calf heifers	Mature cows
	Kg DM/cow/day	
1	14,1	16,4
2	15,9	19,1
3	17,3	20,9
4	18,2	22,3
5	18,6	23,6

Source: NRC (2001:23)

Factors that have an effect on the dry matter intake are:

- Roughage quality: Dairy cows typically consume 0,9% of their body weight as forage neutral detergent fibre (NDF). Lower forage quality means reduced dry matter intake (NRC, 2001:22), which in turn will result in lower milk production.
- Freshness of the ration.
- Dietary composition and fibre length.
- Moisture content: When total ration moisture from fermented feeds exceed 55%, DMI can decline with 3-5% (NRC, 2001:22).
- Feeding frequency: If cows are restricted or removed from feed for more than four hours, dry matter intake may be limited.
- Feeding system (TMR vs concentrates separately).
- Water supply.
- Management.
- Weather conditions.

### 3.3.2 Nutrient Requirements

It is very important to get the help of feed specialist when formulating a feed ration for dairy cattle. The values given in Table 3.11 are guidelines for the nutrient requirements and dietary recommendations for dairy cows, as set up



### 3.3.3 Body Condition Score (BCS)

Body condition scoring is a subjective measure of body fat stored (Ferguson, 1996). It is an important management tool for maximising milk production (and income) and reproductive efficiency while reducing the incidence of metabolic and other peripartum (round calving) diseases (Elanco, 1997). Typical systems use a scale of one to five, but some systems also use a scale of one to nine. The most common system used in South Africa is the one to five system with quarter point increments, where a cow with a condition score of one is emaciated, two is thin, three is average, four is fat and five is obese. Body condition scoring should be done by the person who is responsible for feeding the herd (Rodenburg, 2004), and must be discussed with the nutrition advisors and herd veterinarian. This must be done regularly to reflect changes in fat reserves in each stage of lactation.

According to Ferguson (1996), the ideal body condition is a range and a function of the stage of lactation. Dry cows need sufficient body reserves to support early lactation, but fatter cows are at risk for metabolic diseases after calving. The Nominal Group of experts identified the optimal BCS for dry cows as minimum of three. This is supported by Ferguson (1996), who identified the optimal score between three and three comma seven five (3,75).

Ferguson (1996) identified optimal body condition scores for the different stages of lactation, which is presented in Table 3.12.

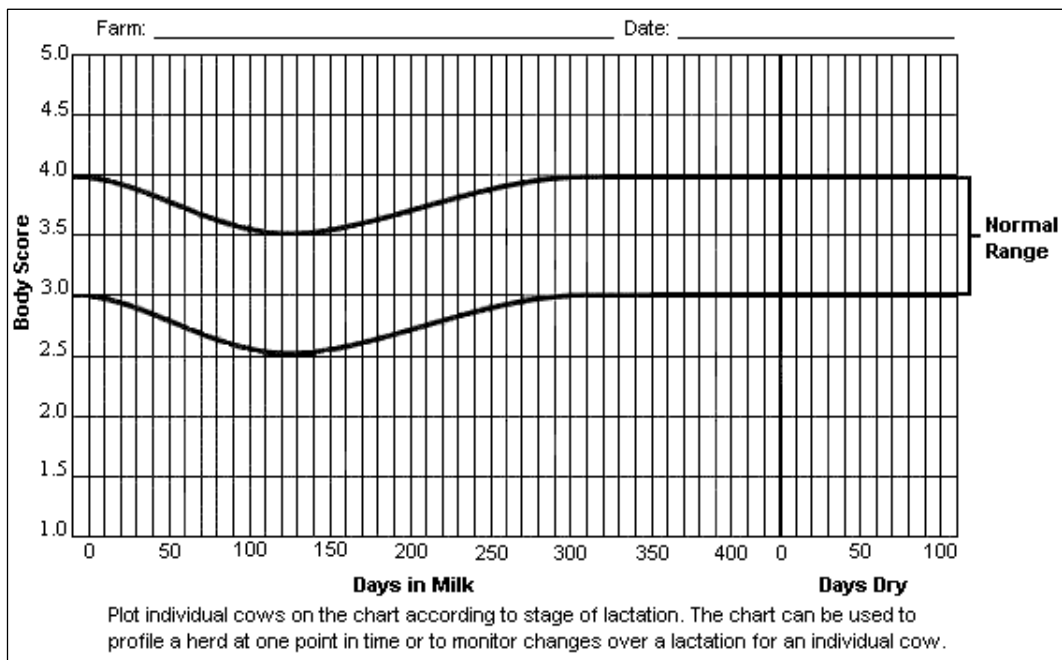
**TABLE 3.12: Optimal body condition score at different stages of lactation**

Stage of lactation	Optimal Body Condition Score
Dry cows	3,25 - 3,50
Early lactation	> 2,50
100 -120 Days in milk	2,50 - 3,25
200 Days-in-milk to dry-off	2,75 - 3,50

Source: Ferguson, 1996

Body condition scoring can also be approached by ranking the percentage of cows that are too thin or too fat (Ferguson, 1996). Dry cows below 3,00 are too thin above 3,50 are too fat. The Nominal Group of experts noted that it is acceptable to have 10% of the group to be outside the range. Similarly, if more than 10% of cows-in-lactation are below a BCS of two, there are too many thin cows in the herd.

Rodenburg (2004), identified a table or chart to use for plotting the cows according to their herd body condition. The chart can then be used to profile the herd at one point in time or to monitor changes over the lactation of an individual cow. The chart is presented in Figure 3.2.



Source: Rodenburg, 2004

**FIGURE 3.2: Dairy herd body condition score chart**

### 3.3.4 Calf and Heifer Feeding Benchmarks

#### a. Colostrum period:

Heinrichs, *et al* (2003:7) defined colostrum as the first milk produced after a normal dry period and it is an essential part a new-born calf's survival. As the first food source, colostrum provides all the essential nutrients to increase metabolism and stimulate digestive activity. It is also the source

of a passive immune system, without which a calf is born. The quality, quantity and timing of feeding colostrum are factors affecting calf morbidity and mortality. True colostrum contains twice as much dry matter, three times as many minerals and five times more protein as whole milk (Table 3.13). Two factors dictate colostrum quality: immunoglobulin concentration (IgG) and the presence or absence of bacteria. Good quality colostrum contains at least 50 g/L of IgG.

The Nominal Group of experts noted that within the first 24 hours, calves should receive 10%-12% of their birth weight as first milk colostrum, two litres within the first two hours followed by another two litres within two hours after birth. The calf's ability to absorb immunoglobulin is reduced by 50% between birth and 12 hours and is lost 24-36 hours after birth (Erasmus, anon).

**TABLE 3.13: Typical composition of colostrum and transitional milk**

Item	Milking number			
	1	2	3	Milk
Solids (%)	23,9	17,9	14,1	12,9
Protein (%)	14,0	8,4	5,1	3,1
IgG (mg/ml)	32,0	25,0	15,0	0,6
Fat (%)	6,7	5,4	3,9	4,0
Lactose (%)	2,7	3,9	4,4	5,0
Minerals (%)	1,1	1,0	0,8	0,7
Vit A (ug/dl)	295,0	190,0	113,0	34,0

Source: Heinrichs, *et al* (2003)

Calves may be started on a milk replacer when four to six days old (Heinrichs, *et al* (2003:14)), but the switch from whole milk to milk replacer should be gradual. Table 3.14 shows the recommended (benchmark) nutrient composition of a milk replacer. Economics is the major reason for feeding milk replacers, since the replacer is composed of by-products from the cheese industry (Heinrichs, 2003), but it is important to feed a good quality milk replacer

The pre-weaned calf requires both liquid and dry feeds and should be offered a dry grain mix at three days of age. During the first week calves eat very little grain, but the intake should increase significantly during the second week (Heinrichs, *et al* (2003:21)). The early intake of dry feed is important for the stimulation of rumen development. Calves should consume calf starters until 12 weeks of age with intake limited to 1,3 - 2,3 kg/day (Erasmus, *annon*) The starter must be palatable and not dusty to encourage intake. Erasmus said that weaning according to starter intake (450 - 700 g/day for three consecutive days) is a good practice. The recommended nutrient contents of a good quality calf starter are shown in Table 3.14.

**TABLE 3.14: Recommended nutrient contents of milk replacers and calf starters**

Nutrient	Milk Replacer	Calf Starter
	Amount	Amount (Dry Matter Basis)
Minimum crude protein (CP) (%)	20 - 28	18 - 20
Minimum fat (%)	10 - 22	3,0
Maximum crude fibre (%)	1 - 2	
Acid detergent fibre (ADF) (%)	-	11,6
Neutral detergent fibre (NDF) (%)	-	12,8
Metabolisable energy (ME) (Mcal/lb)	-	1,49
<b>Macro minerals (%)</b>		
Calcium	1,0	0,7
Phosphorus	0,7	0,45
Magnesium	0,07	0,1
Sulphur	-	0,2
Potassium	-	0,65
<b>Trace minerals (ppm)</b>		
Manganese	-	40,0
Iron	100	50,0

Copper	-	10,0
Zinc	-	40,0
Cobalt	-	0,1
Iodine	-	0,25
Selenium	0,3	0,3
<b>Vitamins (IU/lb)</b>		
A	4091	1818
D	273	273
E	22,7	11,4

Source: Heinrichs, *et al* (2003), adapted from NRC (2001)

*b. Growth rate – Replacement heifers:*

James (2001:63) noted that the goal of a dairy heifer-rearing programme is to provide a regimen or diet, which will enable the heifer to develop her full lactation potential at the desired age and at minimum expense. For Holstein heifers the optimal time for first calving is 22-24 months, weighing 550-600 kg. In addition to body size at calving, rate of growth during various times of the rearing period can have an impact on mammary development and lifetime performance. Table 3.15 gives the optimum body size benchmarks of Holstein replacement heifers at first calving.

The Nominal Group of experts noted that it is important to weigh and measure heifers regularly, to determine if they grow according to standards. Hutjens (1999) also stated that monitoring of weight changes can provide valuable information on the energy status of animals. These standards or benchmarks differ between breeds, but for the three main dairy breeds in South Africa it is as follows:

- Jersey:                   ± 0,550 kg/heifer/day
- Holstein:                 ± 0,750 - 0,800 kg/heifer/day
- Ayrshire:                ± 0,600 kg/heifer/day



**TABLE 3.15: Optimum body size criteria of Holstein replacement heifers at first calving**

Criteria	Average	Lower	Upper
Body weight, kg (14 days pre-partum)	621	596	646
Body weight, kg (7 days post-partum)	560	537	582
Body weight, kg (30 days post-partum)	522	500	542
Wither height, cm	139	138	141
Body length, cm	171	169	173
Pelvic area, cm <sup>2</sup>	> 260	> 260	> 260
Body condition score	3,5	3,5	3,5

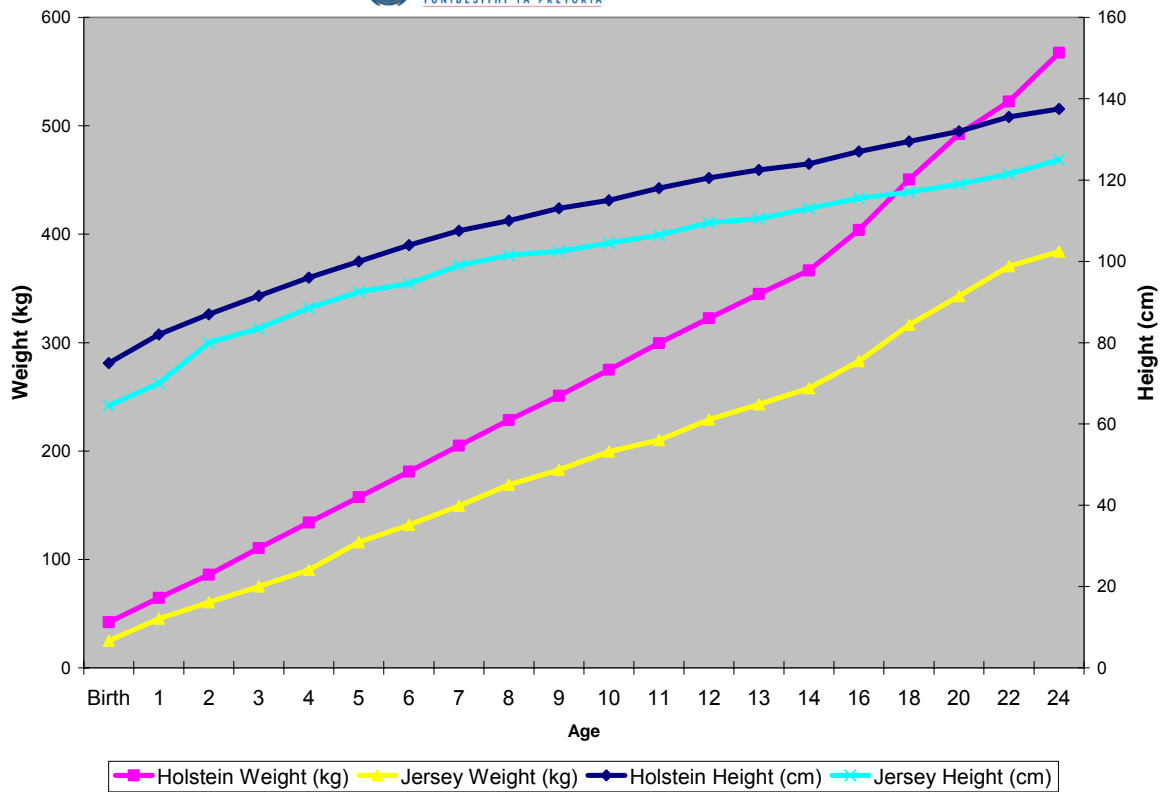
Source: James (2001), adapted from NRC (2001)

*c. Body weight and height:*

Monitoring weight changes in dairy cows provides valuable information regarding the energy status of the cow (Hutjens, 2003:26). High producing cows will lose weight to provide for the high energy levels needed in early lactation. Hutjens (2003) provide guidelines that can be used to assess weight status:

- One body condition score (BCS, see 3.3.4) is equal to 54,4 kg of body weight.
- Cows should not lose more than 1 to 1,5 BCS points.
- The maximum weight loss is 0,90 kg/day to avoid negative effects on reproduction and metabolic disorders.
- Cows should be at optimum BCS before drying off.

The birth and mature weight also differ between the breeds, but the following weights and heights at various ages can be used as benchmarks. Table 3.16 gives benchmark weights and height for Holstein and Jersey animals. These growth charts is presented in Figure 3.3. In Table 3.17 benchmarks weights at different ages for three major dairy breeds in South Africa are given.



Source: Compiled from Erasmus (anon)

**FIGURE 3.3: Body weight and height of Holstein and Jersey animals**

**TABLE 3.16: Benchmark weights and heights: Holstein and Jersey cows**

Ages	Holstein		Jersey	
Months	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)
Birth	39 - 45	74 - 76	23 - 27	63 - 66
1	59 - 70	80 - 84	42 - 49	66 - 74
2	77 - 95	85 - 89	55 - 66	76 - 84
3	102 - 119	89 - 94	70 - 80	81 - 86
4	123 - 145	94 - 98	83 - 98	86 - 91
5	145 - 170	97 - 103	106 - 126	89 - 96
6	167 - 195	101 - 107	118 - 146	91 - 98
7	189 - 221	105 - 110	136 - 163	96 - 102
8	212 - 245	107 - 113	152 - 186	99 - 104
9	231 - 271	110 - 116	168 - 197	100 - 105
10	254 - 296	111 - 119	179 - 220	102 - 107
11	277 - 322	115 - 121	194 - 226	104 - 109

12	300 - 345	118 - 123	209 - 249	107 - 112
13	322 - 368	120 - 125	227 - 259	108 - 113
14	340 - 393	121 - 127	243 - 273	112 - 114
16	369 - 439	124 - 130	266 - 300	113 - 118
18	420 - 481	127 - 132	291 - 342	115 - 119
20	456 - 529	129 - 135	317 - 369	117 - 121
22	488 - 557	131 - 140	344 - 397	119 - 124
24	522 - 613	132 - 143	359 - 409	121 - 129

Source: Erasmus (anon)

**TABLE 3.17: Benchmark weights at different ages for the major breeds**

Breed	Birth weight	13 months	24 months	Mature weight
<b>kg</b>				
Jersey	27	250	400	450
Holstein	40	360	600	700
Ayrshire	32	300	450	500

Source: Kane-Berman, G.D.S. 2004

### 3.3.5 Other Feed and Nutrition Related Benchmarks

There are also a number of other feed or nutrition related benchmarks that could be used in the evaluation of a dairy farm.

#### a. *Feed efficiency or dairy efficiency*

Feed efficiency is a measure of how well cows convert the nutrients they eat into products, namely milk, muscle, fat and calves (Hall, 2004:29). Two versions of feed efficiency can be calculated:

##### 1. Milk/Dry matter intake

Preferably fat and protein corrected milk per kilogram dry matter intake is the simplest version of feed efficiency. According to Hall (2004:30) dr Mike Hutjens suggests that herds should average a feed efficiency of more than 1,4. High producing groups can get a feed efficiency ratio of 1,7 to 1,8. Herds with heat stress, poorly balanced rations, acidosis, etc may have values less than 1,2.

Feed efficiency is calculated as follows:

$$\text{Feed efficiency} = \text{Average milk (kg)} / \text{Average dry matter intake (kg)}$$

Where:

$$\text{Dry matter intake} = (\text{kg feed offered} - \text{kg feed refused}) \times (\text{ration dry matter\%/100})$$

Factors that can impact on feed (dairy) efficiency (DE) are (NRC, 2001):

1. Herds with fresh cows or just coming in milk will have a higher DE.
2. Herds with more young cows may have a lower DE, since young cows divert nutrients to growth.
3. High milk production groups will have a higher DE than lower production groups.
4. Rumen acidosis will lower DE as feeds' digestibility is lower.
5. High quality forage increases DE.

## 2. Milk Nitrogen/ Nitrogen Intake

This measure of efficiency gives an index of feed protein utilisation, and usually decreases when milk urea nitrogen (MUN) values increase (Hall, 2004:31). This ratio is calculated as follows:

$$\begin{aligned} \text{N Efficiency} &= \text{Milk N} / \text{Feed N} \\ &= \text{kg milk nitrogen} / \text{kg feed nitrogen} \end{aligned}$$

Where:

$$\text{Milk nitrogen, kg} = (\text{kg milk} \times (\text{milk protein\%} / 100)) / 6,38$$

$$\text{Feed nitrogen, kg} = (\text{kg DMI} \times (\text{ration CP\%} / 100)) / 6,25$$

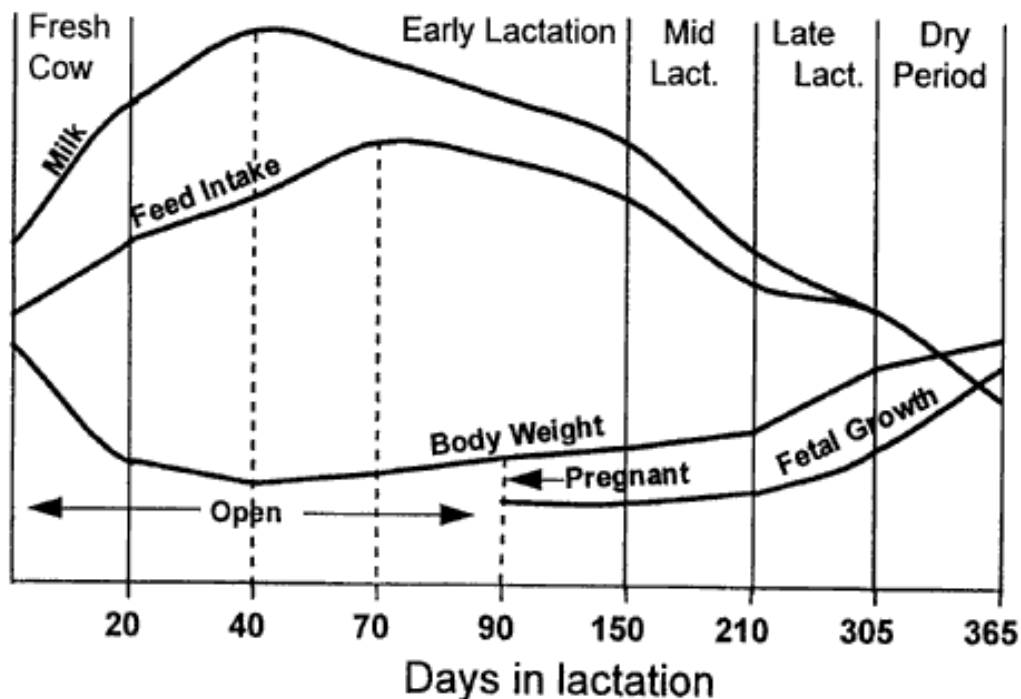
Hall (2004) noted that feed efficiency is affected by the following factors:

- Changes in maintenance requirements
- Weight gain or loss
- Feed digestibility
- Dry matter intake
- Sick cows
- Days-in-milk
- Most limiting nutrient

Enhancing feed efficiency while maintaining high milk production can offer a better economic return on money invested in feed and decrease the loss of nutrients through manure.

*b. Milk production records*

Milk production records can be a valuable tool to evaluate nutritional changes (Hutjens, anon). Adams, *et al* (1998:1) set a benchmark for the average daily milk production for a Holstein cow with decent nutrition and feeding management at a minimum of approximately 26 litres (60 pounds) of 4% fat corrected milk. Peak milk production should occur 40 to 60 days after calving (Figure 3.4), with first lactation cows reaching a peak milk level of 75% or greater than that of mature cows (Hutjens, 2003). Adams, *et al* (1998) also noted that after animals have reached peak milk production, the average decline in milk per month generally is 10%-15% for most of the lactation period.



Source: Phatak, 1999.

**FIGURE 3.4: Typical lactation and reproductive cycle of high producing dairy cows**

c. *Milk composition*

Milk composition can reflect changes in rumen pH, nutrients delivered in the ration's dry matter and shifts in body weight loss (Hutjens, anon). Normal (benchmark) milk fat and protein relationship for the three major dairy breeds in South Africa is given in Table 3.18.

**TABLE 3.18: Milk fat and protein composition for the three major dairy breeds in 2002**

Breed	Milk fat (%)	True protein (%)	Ratio (%protein/%fat)
Holstein	3,66	2,98	0,81
Jersey	4,56	3,55	0,78
Ayrshire	3,84	3,12	0,81

Source: Nutritional troubleshooting: Back to basics (Hutjens, anon)

According to Hutjens (anon), days-in-milk can provide valuable information relating to feeding effects that is obtained from data from milk fat tests:

- Less than 50 days-in-milk: High milk fat tests (more than one percentage point above breed average, such as 5,6 for Jersey cows), reflect excessive weight loss, while low fat tests can reflect energy shortages.
- From 50 to 150 days-in-milk: Milk fat tests will be at their lowest unless negative rumen effects have occurred.
- From 150 days to the end of lactation: Milk fat should be normal for the breed.

Milk protein patterns should follow milk fat patterns as listed in Table 4.17. If milk fat is below milk protein by 0,2 points, rumen acidosis could be occurring.

d. *Milk Urea Nitrogen : MUN-values*

MUN analysis is presently available with the traditional fat, protein and lactose values for all participants in the National Dairy Cattle Performance and Progeny Testing Scheme (Erasmus, 2001: 16). Blood urea nitrogen

(BUN) and MUN are indicators of the protein status and indirectly of the energy status and health of the dairy cow (Erasmus, 2001). High levels of urea have a negative effect on reproduction and high levels of urea in milk can impair cheese production. High levels of urea also points to uneconomic nutrition due to inefficient utilisation of nutrients.

MUN values, just as with fat percentage, protein percentage and SCC, is determined by apparatus based on infra-red technology, but paper test strips are also available for MUN determination. These strips are less accurate than infra-red values, but can serve as a warning that a nutritional problem might exist (Erasmus, 2001). The values are normally presented as mg/100ml.

The general recommendation is that average MUN levels of milk in a herd may vary from 12-18 mg/100ml. Individual cows may vary from 8-25 mg/dl. It is important to note that the baseline MUN-value in a herd where roughage is highly fertilised pastures, will be higher than in a herd on a total mixed ration.

e. *Blood serum*

Serum beta hydroxybutyrate (BHBA) is measured by taking a blood serum sample from cows five to fifty days after calving at four to five hours after eating a meal. Serum levels over 14,4 mg per decilitre in 10% or more of the sampled cows indicate sub-clinical ketosis. Sub-clinical ketosis could reflect a poor transition cow programme, low dry matter intake, heavy cows and other metabolic diseases (Hutjens, anon).

Plasma non-esterified fatty acids (NEFA) reflect if cows are mobilising body weight to meet energy shortages. Blood is taken from cows two to fourteen days before calving. If more than 10% of cows tested sampled over 0,400 milli equivalent per litre, a potential energy deficiency may be occurring in the herd, which can lead to metabolic disorders (Hutjens, annon).

f. *Rumen and urine pH*

Rumen pH is measured by testing 12 or more cows four hours after eating, using rumen tape or rumenocentesis. If over 25% of the cows have rumen pH values below 5,5, sub-acute rumen acidosis may be occurring.

Normal urine pH is over eight but urine pH from cows receiving anionic salts to prevent milk fever should average 6,0 to 6,5 for Holstein cows and 5,5 to 6,0 for Jersey cows. Sample a minimum of eight cows at four to eight hours after the cows have consumed feed (Hutjens, 2003).

g. *Feed particle size*

Measuring forage particle size using the New Penn State Forage Particle Separator is an objective method to evaluate if a TMR have optimal forage particle size. The guidelines for the weight on each sieve are given in Table 3.19.

**TABLE 3.19: Penn State particle box guidelines on an as fed basis**

Screen	Particle Size	Corn Silage	Haylage	TMR
	<i>inches</i>	<i>% of total</i>		
Upper sieve	> 0,75	3 - 8	10 - 20	2 - 8
Middle sieve	0,31 - 0,75	45 - 65	45 - 75	30 - 50
Lower sieve	0,07 - 0,31	30 - 40	20 - 30	30 - 50
Bottom pan	< 0.07	< 5	< 5	≤ 20

One inch = 25,4 mm

Source: Heinrichs, *et al* (2002)

Heinrichs, *et al* (2002:6) mentioned that if the minimum fibre requirements are not met, cows may show one or more of the following disorders: reduced milk fat percentage, displaced abomasums, laminitis and rumen acidosis.

h. *Evaluating silage fermentation*

Evaluating for example the fermentation characteristics, forage quality, and moisture content, the process of silage-making can be improved controlled



and improved on. To evaluate silage fermentation a sample of the silage has to be sent to a commercial laboratory. Table 3.20 gives the recommended fermentation profile for ensiled feed.

**TABLE 3.20: Recommended fermentation profile for ensiled feed**

Measurement	Legume/grass mixture			Corn Silage
	< 35	35 - 50	> 50	
Dry matter (%)	< 35	35 - 50	> 50	35 - 40
pH	4,0 - 4,3	4,3 - 4,7	4,7 - 5,0	3,8 - 4,2
Lactic acid (%)	6,0 - 8,0	4,0 - 6,0	2,0 - 4,0	5,0 - 10,0
Acetic acid (%)	1,0 - 3,0	0,5 - 2,5	0,5 - 2,0	1,0 - 3,0
Propionic acid (%)	< 0,5	< 0,25	< 0,10	< 0,10
Butyric acid (%)	< 0,5	< 0,25	< 0,10	< 0,10
Ethanol (%DM)	< 1,0	< 1,0	< 0,5	< 3,0
Ammonia (%CP)	<15,0	< 12,0	< 10,0	< 8,0
Lactic/Acetate	>2,0	> 2,5	> 2,5	> 3,0
Lactic (% total)	> 60	> 70	> 70	> 70

Source: Dairyland (2000) from Hutjens (anon)

*i. Manure evaluation*

Manure evaluation is not a precise science and cannot provide definitive answers to nutritional questions, but it can be a useful tool for some health related issues (Kononoff *et al* (2002:2)). Manure can be evaluated according to colour, consistency and content. Hutjens (anon) noted that Michigan workers developed a scoring system to evaluate fresh manure. A scale of 1 to 5 is listed, with a score of 3 as the optimal:

- Score 1: Manure is very liquid with the consistency of pea soup. Excess protein or starch, too much mineral or lack of fibre may be the cause.
- Score 2: Manure appears runny and does not form a distinct pile. Low fibre may be the cause.
- Score 3: Manure is porridge like, will stack up 38 to 51 millimetres, have several concentric rings and will stick to the toe of a shoe.
- Score 4: The manure is thicker and stacks up over 51 millimetres. Adding more grain or protein can lower the score.

- Score 5: Manure appears as firm faecal balls. Feeding a straw-based diet or dehydration contribute to this score.

Manure scores 1 and 5 are not desirable and may reflect a health problem besides dietary limitations. Score 2 and 4 may reflect a need to rebalance the ration. It is also important to note that manure scores may shift as the cow progresses through her lactation.

### **3.4 Benchmarking Norms – Economic and Financial Indicators**

Van Zyl, *et al* (1999) noted that when the financial position of a dairy farm is evaluated it is important to take the following into account:

- Norms or parameters shall differ from norms of other production sectors.
- Norms within agriculture will differ between:
  - Young farmers and established farmers.
  - Regions.
  - Sectors within each region.
  - Small and large farmers.
  - Risks associated with each farm.
  - Seasons.
- The norms must be interpreted with care, especially if valuations, income and expenses are not reflected correctly or if cash flow is not taken into account.

When costing self-produced fodder (Coetzee, 2006) it is important to differentiate between production and opportunity costs and which one is used as base for the calculation of total cost, as well as other costs. Coetzee (2000) mentioned that production inputs (seed, fertilizer and diesel) must be bought at a certain cost, the production cost. Cost is determined by the value of the inputs used in the production process, or otherwise the value-units that are necessary to replace the inputs. Opportunity costs, the possible income that could have been received for the products if it were sold on the market,

therefore form the basis for the calculation of costs and are accepted by economists (Coetzee, 2000).

Differentiation between economic cost and accounting cost must also be made (Salvatore, 2001:288). Economic costs take the opportunity costs into account, while accounting costs are just the historical costs needed for financial reporting. Salvatore (2001:288) mentioned that economic cost or opportunity cost must be used for managerial decision-making purposes. The opportunity costs will be used for the purpose of benchmarking throughout the study.

Swensson and Herlin (2005) identified that the traditional tools in Swedish extension services for economic management on dairy farms have to use results from the farmer's own accounts. This has the benefit that the farmer knows the economic results. A disadvantage is that the results are based on historical data. Through benchmarking in milk production the aim was to make dairy farmers think in terms of net income instead of high milk yield and to identify the weakest link in their milk production system.

When one evaluates a farm the above-mentioned factors, as given by Van Zyl, *et al*, must be taken into account. The Nominal Group experts identified and quantified a few economical and financial benchmarks that can be used in the evaluation of a dairy farm which is given in the following section.

### **3.4.1 Total Cost**

Total cost includes fixed costs as well as all the variable costs associated with milk production. Total cost should be less than 75% of gross income for a dairy farmer on a TMR-based production system.

### **3.4.2 Feed Cost**

Feed costs for a dairy farmer on a TMR-based production system should be 57% of gross income or 69% of total cost.

### 3.4.3 Other Variable Dairy Costs

Other variable dairy or dairy related costs should be not more than 8% of gross income or 10% of total cost. Such dairy costs include the following:

- Veterinary services and medicines
- Artificial insemination
- Detergents
- Repair and maintenance of milking equipment
- Direct labour costs
- Sundry dairy costs.

### 3.4.4 Overhead Costs

The Nominal Group indicated that overhead costs should be less than 25% of gross income or 21% of total costs for a typical dairy farmer with a TMR-based production system on the Highveld.

### 3.4.5 Solvability

Van Zyl, *et al* (1999) defined solvability as the ratio between the firm's assets and liabilities. In other words, the ability of the firm to pay its debts, if the operation were to seize to exist. Solvability can be measured in different ways and when interpreted correctly, gives the same answer (Barry *et al* (110-111)). But it is important to establish the correct values of assets (Van Zyl, *et al*, (1999)) in order to calculate the correct ratio. Low (incorrect) asset values, for example, will result in lower ratios. Creditors normally give a lot of attention to the solvability ratios, and skew ratios due to incorrect asset values can give a negative image of the business. It is therefore always important to be honest and give realistic assets values, such as market or correct replacement values, instead of out of context low or high values.

a. *Net capital ratio*

This ratio is defined in more than one way. Van Zyl, *et al* (1999) defined it as the ratio between total assets and total liabilities or total assets/total liabilities.

Barry, *et al* (1988:78) and Brockett *et al* (1997) defined the net capital ratio as:

$$\text{Net capital ratio} = (\text{Total farm debt} / \text{Total assets}) \times 100$$

Although Barry *et al*'s and Brockett *et al*'s definition is the reciprocal of that of van Zyl *et al*, deductions based on these definitions ought to be the same.

A financial feasible benchmark (van Zyls, *et al*'s definition) for net capital ratio of greater than 2:1 was quantified by the Nominal Group, although a lower value can also be viable if the variable cost is high and the milk price unstable. Van Zyl, *et al* (1999) gave a ratio of 2:1 as a rule of thumb.

Brockett, *et al* (1997), as well as the Nominal Group of experts, set a standard of 40% as a competitive benchmark for the definition D/A (Table 3.21). Brockett, *et al* (1997) mentioned that the D/A ratio will vary through the life cycle of the business. Higher ratios are common in new and expanding businesses. A low D/A ratio are only one indication of the financial condition of the business. When evaluating the business, one must also look at the liquidity of the business, its ability to meet cash obligations and its profitability.

**TABLE 3.21: Financial position in relation with D/A ratio**

D/A ratio %	Financial position of the business
< 40	Strong
40 - 70	Possibly stressed
> 70	Very stressed

Source: Brockett, *et al* (1997)

b. *Leverage ratio*

The leverage is defined as the ratio of total liabilities to own capital (equity) of the firm. In other words it can be defined as the debt/equity (D/E) ratio.

This ratio gives an indication of the farmer's ability to cover liabilities by his own funds.

c. *Firm's growth*

A firm's growth is defined as the increase in net value from one year to another. Only the net value is of importance, since it reflects the growth of the owner's own capital. Van Zyl, *et al* (1999) gives the following formula for the calculation of the firm's growth:

$$\text{Firm's growth} = \frac{(\text{Net value Year 2} - \text{Net value Year 1}) \times 100}{\text{Net value Year 1}}$$

The benchmark norm for the firm's growth is not a fixed value, but the farmer or manager must ensure that the growth is higher than the inflation rate, in order to obtain real growth. Currently a growth rate of more than 6% will be acceptable.

### 3.4.6 Liquidity

According to Van Zyl, *et al* (1999) liquidity can be defined as the ability to fulfil all the short-term liabilities as they become due. This includes production costs, interest and compulsory debt payments. The most common liquidity ratios that were identified by the Nominal Group that are commonly used in the evaluation of dairy farmers are the following:

a. *Current ratio*

Van Zyl, *et al* (1999) define the current ratio as the ratio between the current assets and current liabilities, or

$$\text{Current ratio} = \text{Current Assets} / \text{Current Liabilities}$$

The benchmark given for the current ratio is a ratio of more than 2:1.

A persistently low current ratio indicates a major cash flow problem (Brockett, *et al*, 1997). To rectify this Brockett suggests to refinance

existing debt with longer repayment terms or to sell non-essential intermediate assets. A current ratio that is too high, for instance, indicates surplus cash. Current assets normally generate lower returns than other assets. Investing in higher return assets might be an option.

*b. Cash flow*

According to Van Zyl, *et al* (1999: 61) cash flow is the most important aspect of financial management for a farm business. Cash flow can be determined on a cash basis or on an accounting basis. It is preferable to use the *cash* basis, therefore not including non-cash items. This will show a more realistic growth or decline in the farmer's net worth. Cash on hand at the beginning of the period plus all cash inflows comprise the sources of cash for the business, while cash outflows plus cash on hand at the end of the period comprise the uses of cash. For accounting purposes this must be equal.

Cash outflows can be used to pay operating expenses, make capital investments, reduce debt, support family withdrawals or remain as cash on hand for the next period (Barry, *et al*, 1988:43). The cash flow statement indicates all in- and outflows of cash during the month and compares it to budgeted values (Coetzee, 2006). Any deviation from the planned budget, e.g. income that is below or expenses that is above budget, has to be explained and corrective actions taken.

Cash flow budgets can also be used to negotiate with creditors. It therefore sets a basis for credit as well as financial management. It also focuses on the feasibility of a project. Due to the nature of the cash flow budget, it is difficult to set a definite benchmark for cash flow, but the aim is to have a positive cash flow throughout the year to ensure liquidity and profitability.

*c. Operating expense ratio*

This ratio indicates the percentage of gross farm income used to pay operating expenses (Brockett, *et al*, 1997).

$$\text{Operating expense ratio} = (\text{Total operating expenses} - \text{Interest}) / \text{Gross farm income} \times 100$$

Operating expenses excluding interest should be less than 70% of gross farm income. The lower the percentage, the more money will be available for re-investment in the dairy business, e.g. loan repayments and, improvements and investing savings that is a risk barrier.

Low expenses are desirable only if production and income do not suffer. An operating expense ratio of above 70% may reflect high expenses, low income or both. According to the Nominal Group, the largest single expense for a dairy farm, with a TMR-based production system, is purchased feed. It is therefore crucial to ensure that feed costs, and other costs, are in line with competitors' expenses or industry indicators, to be successful.

### 3.4.7 Profitability

The Nominal Group of experts identified two profitability measures, which they deem as important in a dairy farm, as benchmarks.

#### a. Profitability on total capital

Van Zyl, *et al* (1999) defines the profitability on total capital as the percentage of net farm income in relation to the average total capital applied during the financial period.

$$\text{Profitability on total capital} = (\text{NFI} \times 100) / \text{Average total capital}$$

The Nominal Group indicated a profitability level of 10% as acceptable under reigning economic and financial conditions in the dairy industry.

#### b. Profitability on own capital

Profitability on own capital is the profitability earned after borrowed capital is paid. It is calculated as follows:



$$\text{Profitability on own capital} = (\text{NFI} \times 100) / \text{Average own capital}$$

The benchmark figure identified is greater than 10%.

### 3.4.8 Debt Repayment

The Nominal Group of experts identified three debt payment ratios that can be used in the evaluation of dairy farms.

a. *Cost of debt ratio*

$$\text{Cost of debt} = (\text{Interest paid and accrued}) / \text{Average debt}$$

A ratio of less than 10% was given as a benchmark parameter by the Nominal Group. It should be noted that as the repo rate changes, the feasible size of this ratio will also change.

b. *Debt service ratio*

This ratio determines the ability of the firm to pay its debt (Van Zyl, *et al*, 1999).

$$\text{Debt service ratio} = (\text{Interest payments} + \text{Instalments}) / \text{Gross production value}$$

A ratio of less than 18% was identified as the benchmark for dairy farmers.

c. *Required profitability*

This ratio is defined as the required NFI to service debt and investment, per R100 total capital invested. Benchmarks are based on the average cost of capital and the debt ratio. Table 3.22 is a summary of the benchmarks for the required profitability. Table 3.22's information can also be used to indicate the maximum debt percentage that can be managed, at different interest rates and NFI. It is important to note that the figures

stated are the minimum percentage to service debt, but exclude living expenses.

**TABLE 3.22: Benchmarks for the minimum required profitability**

Debt ratio Liabilities/Assets	Weighted average costs of capital			
	12%	15%	18%	20%
50%	6,0%	7,5%	9,0%	10,0%
45%	5,4%	6,8%	8,1%	9,0%
40%	4,8%	6,0%	7,2%	8,0%
35%	4,2%	5,3%	6,3%	7,0%
30%	3,6%	4,5%	5,4%	6,0%
25%	3,0%	3,8%	4,5%	5,0%
20%	2,4%	3,0%	3,6%	4,0%

Source: Coetzee, 2006

### 3.4.9 Capital Efficiency Ratio

Capital efficiency as measured by the asset turnover ratio (ATR) measures the efficiency by which farm assets generate revenue. The higher the ATR, the more efficiently assets generate income.

$$ATR = \text{Gross revenue}^* / \text{Average total farm assets}$$

\* Gross revenue = cash sales ± inventory changes ± receivables changes + other farm income.

An ATR greater than or equal to 0,5 is set as a competitive benchmark. If the ATR is less than 0,5 several reasons can be identified: gross revenue might be too low, average farm assets too high, or both. On dairy farms the quantity of milk sold and the milk price have the largest impact on gross revenue, but other factors that influence the profitability of dairy production is also shown in Figure 2.1 (p 29).

### 3.4.10 Summary of Economical and Financial Benchmarks

The financial and economic benchmarks are summarised in Table 3.23. It is important to remember that these norms give a static situation of the business at a given time. It is therefore recommended to do a dynamic evaluation in which the change over time is taken into account by evaluating the norms over a number of periods (Coetzee, 2006) and comparing it with a GMP situation.

**TABLE 3.23: Summary of economical and financial benchmarks**

Parameter		Benchmark
Total cost	% of gross income	75%
Feed cost	% of gross income	57%
	% of total cost	69%
Other variable cost	% of gross income	8%
	% of total cost	10%
Overhead costs	% of gross income	25%
	% of total cost	21%
Solvability	Net capital ratio	>2:1
	Leverage ratio (D/A ratio)	<40%
	Firm's growth	>6%
Liquidity	Current ratio	>2:1
	Cash flow	
	Operating expense ratio	< 70%
Profitability	Profitability on total capital	10%
	Profitability on own capital	>10%
Debt payment	Cost of debt ratio	<10%
	Debt service ratio	<18%
	Required profitability	See Table 4.12
Capital efficiency ratio	Asset turnover ratio (ATR)	≥ 0,5

### **3.5 Benchmarking Norms – Other standards**

The Nominal Group of experts identified the following standards and benchmarks that are important in the evaluation of dairy farms.

#### **3.5.1 Bio-security**

According to Prof Dirk Lourens (Section head of the Herd Health Section at the Faculty of Veterinary Science of the University of Pretoria at Onderstepoort), bio-security<sup>8</sup> is one of the issues neglected on most South African dairy farms. Bio-security is difficult to benchmark according to a set figure or number, but a bio-security protocol must be in place in order to ensure effective bio-security. According to Cortese (2004), a bio-security programme has three facets.

First of all, it is important to have immunisation programmes in place for all the important diseases in the area where the farm is situated. It is also important to have the necessary vaccines available at the appropriate time, but also to have vaccines available that might be necessary in times of an emergency. These vaccines must be stored under the correct conditions and locked away.

Secondly, to maintain a high level of bio-security, it is important to have a closed herd. This means that no animal will be bought in, but the herd will grow through normal offspring. If it is necessary to buy animals in, it is important to have quarantine facilities available where the bought animals can be held for evaluation before introducing them into the herd.

Thirdly, management is a very important part of bio-security. Through good and effective management, which include the training and movement of people on the dairy farm, a high level of bio-security can be maintained.

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<sup>8</sup> Bio-security is defined as the protection of the economy, environment and health of living things from diseases, pests and bio-terrorism.  
([http://encarta.msn.com/dictionary\\_701704642/biosecurity.html](http://encarta.msn.com/dictionary_701704642/biosecurity.html))

*The Guide to Good Dairy Farming Practice* (2004:6) mentioned that “the guiding objective for good dairy farming practice is that milk should be produced on-farm from healthy animals under generally accepted conditions. To achieve this, dairy farmers need to apply good agricultural practice (GAP) in the following areas:

- Animal health
- Milking hygiene
- Animal feeding and water
- Animal welfare
- Environment.

GAP also means that dairy farmers must keep record, especially to enable adequate traceability of:

- The use of agricultural and veterinary chemicals
- The purchase and use of animal feed
- The unique identification of individual animals.

### **3.5.2 Capacity Utilisation**

The Nominal Group of experts identified some benchmarks that are important for the evaluation of capacity utilisation during milking.

#### *a. Milking time*

Milking time is defined as the time lapse from the entry of the cow until she exits the parlour. The benchmark milking time is 8-10 minutes. Although milking time is crucial, it is also important to maintain a proper milking routine. Johnson (2004:271) gave the following steps for a proper milking routine to produce quality milk:

- Strip 2-3 squirts of milk from each teat.
- Pre-dip teats and cover at least 90% of teat. Make sure the pre-dip stays on for a minimum of 30 seconds.
- Wipe teats dry, making sure to clean the teat wall and teat ends.
- Attach unit to the cow’s teats 75-90 seconds after stripping.
- Post-dip to get 90% coverage.

*b. Cows per hour per unit*

Cows per hour/unit are defined as the number of cows that pass through a milking unit in an hour. The benchmark identified is 7,5 - 8,5 cows/unit/hour.

*c. Milking time per session*

The Nominal Group mentioned that the total milking time per milking session should be less than 2,5 hours. This excludes the washing procedure.

### **3.6 Summary**

The Nominal Group of experts that were used in this study identified a number of benchmarks that can be useful for dairy farmers in their benchmarking exercise. It is of importance to note that all the parameters and benchmarks are closely related to each other, as well as to other production factors applicable on a dairy farm.

Herd health and reproduction are very important in the milk production process, and must be seen in a holistic manner since it is dependent on and responsible for various other parameters. Herd health is divided into three main areas, namely fertility performance, udder health and general herd health. Fertility performance can be evaluated according to different primary and diagnostic indexes, as listed. Poor udder health is one of the most costly conditions in dairy herds in the world and the main reason for this is mastitis. To ensure good general herd health, it is important to keep the herd free of all reportable diseases such as tuberculosis and contagious abortions. It is also important to have a vaccination programme in place to ensure general herd health.

Nutrition and feeding is such a specialised production issue in the dairy industry that the knowledge and inputs of animal nutritionists are necessary. The Nominal Group identified in this regard benchmarks which a farmer can use to detect problems in the nutritional and feeding status of the herd. Most of the benchmarks can be determined on-farm, but for some it might be

necessary to send samples to commercial laboratories for analysis. It is important to mention that if a significant variation in a feeding benchmark is noticed, the farmer must get the help of a feed specialist to make the necessary adjustments or recommendations.

Since no two farms are the same, it is difficult to establish exact benchmarks for the financial and economical evaluation of a dairy farm (or any farm). The Nominal Group, however, did identify certain benchmarks to evaluate the dairy farm. The benchmarks can be divided into benchmarks related to costs, solvability, liquidity, profitability, debt payment and capital efficiency.

Lastly the Nominal Group identified a few other benchmarks that can be useful, but not necessarily essential for efficiency. Bio-security is very important and is also linked to herd health and it is therefore necessary to have the essential requirements in place. Capacity utilisation can give the farmer/manager a good indication of the performance of workers and equipment within the milking parlour.

Quite a number of benchmarks were given in this chapter, but to be useful a farmer must determine which have the biggest impact on his business and which can be managed effectively. The Nominal Group identified some indicators or information that must be assessed more frequently than the monthly benchmarks given in this chapter. These indicators are summarised in Table 3.24.

**TABLE 3.24: Indicators to use in the evaluation of a dairy farm**

Indicator	Reason
<b>Daily information</b>	
Total milk production	Milk production directly affects income. Deviation in milk production can be an indication of some areas of concern.
Concentrate given and concentrates left uneaten	The difference between the concentrates given and that left uneaten, is the feed intake. Reduced intake may indicate different problems. The ration between feed intake and milk production is also important for profitability.
<b>Weekly information</b>	
Number of AI's	Indication of fertility.
Number of calvings	Indication of reproduction.
Number and reason of medicines given	Indication of herd health.
Production curve of cows	Indication of future production, cow health, etc.



## CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

### ***4.1 Introduction***

The main aim of this study was to identify and quantify, where possible, certain critical benchmarks or norms against which dairy farmers on the Highveld can evaluate their farm operations. The first objective is to be sustainable and thereafter to be profitable.

### ***4.2 Approach Followed***

The Nominal Group Technique, which was selected to identify the critical benchmarks was explained and discussed. This method was chosen due to its numerous advantages over other group methods. A panel of experts was established for every important leg of dairy production, namely:

- Animal and herd health
- Reproduction
- Feeding and nutrition
- Economics
- General production matters.

Benchmarking was introduced and defined as a process of comparing a firm's performance against the "best" practices of other leading companies for the purpose of improving the former firm's performance. Benchmarking, as a form of comparative analysis, is a well known technique, but the current form of benchmarking can be accredited to Xerox, who decided to examine and compare the unit costs of its competitors.

Four different types of benchmarking can be identified, namely:

1. Industry group measurements
2. “Best practice” studies
3. Cooperative benchmarking,
4. Competitive benchmarking.

The simplest benchmarking model consists out of the following six steps:

1. Planning
2. Research
3. Observation
4. Analysis
5. Adaptation
6. Improvement.

Benchmarking will only be useful when it leads to improvement in the competitive performance of a firm or, in this case, a farm. Benchmarks will only be successful if it is:

- Unambiguous. The components should therefore be clearly described.
- Investable. It should be open for active management.
- Measurable.
- Appropriate.
- Understandable and adjustable.

A background introduction of the South African dairy industry was given to give an understanding of the complexity of the industry. It was one of the first agricultural industries to be deregulated from a previously controlled market and one-channel marketing system to a total free market. The climate in South Africa determines to a large extent the type of production system that a farmer will use. Three different production systems can be identified in South Africa: 1) Total mixed ration-based (TMR-based), 2) Pasture-based and 3) Concentrate and roughage-based production systems. The TMR-based system is mainly used by inland farmers and farmers in the Western Cape, while farmers in the coastal regions mainly use the other two production

systems. The different production systems will also result in differences in the benchmark norms for certain critical success factors.

The number of producers decreased over the period 1997-2006, but the production capacity of dairy herds increased over the same period, which is an indication of the increased efficiency of the modern milk producer in South Africa. There was also a clear shift in the geographical distribution of milk production in South Africa. In 1997 52,4% of milk was produced in the coastal regions, but this increased to 64% in 2006.

### ***4.3 Research Results***

Benchmarks for a dairy farmer can be divided into four categories, namely: herd health and reproduction, feeding and nutrition, economic and financial and finally other benchmarks. It is important to note that these benchmarks are all interrelated and must be seen holistically when one evaluates a dairy farm.

Herd health and reproduction benchmarks can be divided into three areas, namely: fertility performance, udder health and mastitis and general herd health. Critical primary and diagnostic indexes can be identified to evaluate fertility performance. The most applicable primary indices are:

1. Herd structure
2. Inter-calf period
3. Days from calf to first insemination
4. Calving to conception
5. Days open
6. Lactation length
7. Dry-period length
8. Culling rates.

The diagnostic indices obtained from the panel of experts are:

1. Conception parameters such as AI conception rate and average services per conception.
2. Efficiency of oestrus detection such as calving to first insemination, ratio of normal to double intervals and service return intervals.

Udder health and mastitis are related in such a way that the incidence of mastitis is a good indication of udder health. A range of losses occurs due to mastitis, which was identified as the single most costly condition of dairy herds. The somatic cell count (SCC) is a very sensitive indicator of the incidence of mastitis and therefore udder health.

Regarding general herd health, it is important to keep the herd free of *bovine tuberculosis* (TB), *bovine contagious abortions* (CA) and *bovine virus diarrhoea* (BVD).

The Nominal Group of experts identified a number of parameters and benchmarks to use in the evaluation of the feeding and nutritional status of a dairy herd. These benchmarks focus on feed intake, nutrient requirements of a ration and body condition scoring, calf and heifer feeding and feed efficiency. Other feeding benchmarks that were identified include: milk composition, MUN values, rumen and urine pH, growth rate, silage fermentation and manure evaluation.

Economical and financial benchmarks that were identified by the Nominal Group can be divided and sub-divided into six sections, namely:

- Cost benchmarks
  - Total cost
  - Feed cost
  - Variable costs
  - Overhead costs
- Solvability
  - Net capital ratio
  - Leverage ratio

- Firm growth
- Liquidity
  - Current ratio
- Profitability
  - Profitability of total capital
  - Profitability of own capital
- Debt repayment
  - Cost of debt ratio
  - Debt service ratio
  - Required profitability
- Capital efficiency ratio

It is important to note that the financial benchmarks for the dairy industry will differ from that of other agricultural industries, as well as other production industries. When the figures are calculated to compare with the benchmarks, it is very important to use correctly and realistically calculated values, otherwise the evaluation will not be accurate.

The Nominal Group mentioned some other benchmarks to use in the total evaluation of the dairy farm. The most important benchmarks of this group are the implementation of a bio-security programme and benchmarks for capacity utilisation such as milking time, cows per hour per unit and milking time per session.

The results obtained from discussions with the experts of the Nominal Group panel and literature sources were verified with international sources where possible and applicable.

## **4.4 Recommendations**

Due to previous structural reasons in the dairy industry, benchmarking did not receive the necessary attention. This study can be regarded as a step towards the development of a more complete set of benchmarks for farmers in their benchmarking exercises.

Based on this study, the following is recommended:

1. The research on benchmarks for dairy production must be extended to other dairy production areas, such as the areas using pasture-based production systems.
2. Benchmarking against international standards is important for the South African dairy industry in order for it to be globally competitive.
3. It is important for farmers to participate in benchmarking and other monitoring schemes. One such scheme, from which farmers can only benefit, is the National Dairy Animal Improvement Scheme. Information received from milk recording is invaluable for herd improvement and essentially, profitability. It is therefore recommended that farmers participate in milk recording.
4. The benchmarks identified in this study can be published in a book or pamphlet by the MPO as a service for the milk producer.
5. It is important for farmers to make use of the Nominal Group technique on their farms. All input suppliers and related parties can meet regularly to evaluate a farm or group of farms and discuss problems and solutions for a specific farmer's situation.

## **4.5 Conclusion**

The main aim of the study was to identify and quantify critical benchmarks for use in the evaluation of dairy farms in the Highveld region of South Africa. From the results and discussion it is concluded that benchmarking a dairy farm is not a clear-cut situation, but rather a complex exercise in which

various factors must be taken into account. But the complexity of the exercise is no reason not to do benchmarking; the benefits reaped will be more than the costs of benchmarking.

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## APPENDIX

### A1: History of the Dairy Industry

#### A.1.1 Milk Board

The Milk Scheme was published by Proclamation No R.8 of 26 January, 1962 in terms of the Marketing Act (Act No. 26 of 1937), superseded by Act No. 59 of 1968, and came into operation on 1 March 1962. This was done after a similar Scheme was put to trial in the Cape Peninsula Area since 29 June 1956, and was considered to be successful.

The Milk Board<sup>9</sup> consisted of seventeen members appointed by the Minister of Agriculture (Annual Report, 1977:3). Of these seventeen members:

- Nine represented producers
- One represented producer-distributors
- Four represented distributors
- Two represented consumers
- One was an officer of the then Department of Agricultural Economics and Marketing.

The Board may also co-opt not more than two persons in an advisory role.

The Scheme relates to milk and cream intended for human consumption in the form of milk or cream or for the manufacturing of ice cream. The main aim of the Milk Scheme was the stabilisation of the fresh milk industry in respect of the five controlled areas and to ensure orderly marketing of fresh milk in these areas. The Board, which administered the Scheme, had no physical control over the handling of fresh milk, but its main function was to regulate the marketing of fresh milk according to the demand in a specific controlled area to the best advantage of producers, distributors and consumers.

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<sup>9</sup> This early Milk Board must not be confused with the Milk Board established in 1994 after the demise of the Dairy Board. See par 3.1.3

A proposed amendment to the scheme was published in January 1976 of which the main purpose was to empower the Board itself, for purposes of orderly marketing, to purchase milk directly from producers and to divide it for marketing among distributors. The Board therefore wanted ownership over not only surplus milk, but also over all fresh milk and cream intended for sale within a controlled area.

The Scheme was at that stage applicable to the following marketing areas:

- Bloemfontein
- Cape Peninsula
- Pretoria
- Western Transvaal
- Witwatersrand .

In terms of the Milk Scheme the Board issued the following types of registrations:

1. **Producer/Permits:** A producer meant any person who produced milk or cream anywhere for sale in an area to which the Milk Scheme were applicable.
2. **Distributor:** A distributor meant any person who purchased milk or cream from a producer for the purpose of resale or who separated the cream from milk so purchased for the purpose of sale of for use in the manufacturing of ice-cream.
3. **Producer-distributor:** A producer-distributor (PD) meant any producer who was permitted by the Board to sell milk in an area milk or cream of which at least eighty percent was produced by him, to persons other than distributors or producer-distributors.

Producer registrations were normally only granted on one specific date, except in the Pretoria Area where it was done twice a year to combat shortages.

The Board has established a milk pool in each of the controlled areas to which:

- Any producer may deliver milk or cream produced by him in excess of the quantity which he can dispose of to distributors or PD's.
- Any PD or distributor on behalf of a producer from whom milk or cream was received, may deliver any quantity in excess of his requirements.

The ownership of any quantity of milk or cream delivered to the milk pool for sale vested in the Board which may process, store, insure, advertise, transport and sell it on the account of such pool. Such milk is disposed of by the Board at the highest possible realisation.

### **A.1.2 Dairy Control Board**

The Dairy Control Board was instituted with effect from 1 March 1979 in terms of the Dairy Control Scheme, published by Proclamation R.290 of 1978 under the Marketing Act, 1968 (Act 59 of 1968), as amended, amalgamating the former Milk Board and Dairy Board. The main purpose with the Dairy Control Scheme, as with the Milk Scheme, was to stabilise the dairy industry and to ensure orderly marketing of all products controlled under the scheme (Dairy Control Board, Annual Report, 1982).

The Dairy Control Scheme relates to dairy products produced in or imported into the Republic of South Africa, and applies to persons producing or dealing with dairy products. Control over fresh milk was restricted to only seven marketing areas, namely Bloemfontein, the Cape Peninsula, Pretoria, the Western Transvaal and the Witwatersrand. Under Proclamation R.72 of 18 April 1980 the regions of Natal and Northern Natal came under control. In 1982 the Pretoria and Witwatersrand areas were consolidated in one area namely the Transvaal Area (Dairy Board, Annual Report, 1983), while the Natal and Northern Natal regions were consolidated in October 1984 (Dairy Board, Annual Report, 1985). In July 1985 the former Western Transvaal and Transvaal regions were consolidated into one area (Dairy Board, Annual Report, 1986), which means that the controlled areas were reduced to only four regions, although the size of the regions did not decrease.



According to the Annual Report of 1982, the Dairy Control Board, in its administration of the Scheme had the following powers, subject to the approval of the Minister of Agriculture<sup>10</sup>:

1. To fix prices for all milk and dairy products under its control, from the primary producer to consumer.
2. To fix minimum rates for the transportation of industrial milk and cream for the production of butter, cheese and condensing milk.
3. To conduct pools for the sale of all creamery butter and factory cheese (Cheddar and Gouda), as well as a surplus pool and milk sales fund for fresh milk in respect of each controlled area.
4. To impose levies and special levies on a dairy product, as well as to establish funds into which all revenue derived from levies must be paid for financing expenditure.
5. To regulate by means of registration the admission into the dairy industry of all dairy factories as well as of distributors of PD's in controlled fresh milk areas.
6. To take the necessary steps for fostering or stimulating the demand, within or outside the Republic, for dairy products.
7. To assist, by grant or loan or otherwise, research work relating to improvement, production, manufacturing, storing or marketing of dairy products.
8. To establish an information service in order to inform producers from time to time about marketing conditions.
9. To acquire or hire property and employ such persons as may be necessary for the proper performance of the Board's functions and for the attainment of the objects of the Scheme.

Although the Dairy Control Board was not physically concerned with the handling of dairy products, it organised, for the purpose of orderly marketing, the flow of fresh milk according to the requirements of the fresh milk market, as well as the flow of creamery butter, Cheddar and Gouda cheese. The Board further had the sole right to import butter and cheese (Cheddar and

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<sup>10</sup> Throughout Chapter 3 the minister will refer to the Minister of Agriculture, unless otherwise specified.



Gouda). Other secondary dairy products may only have been imported under permits granted by the Dairy Control Board.

The Dairy Control Board consists of thirteen members as appointed by the Minister of Agriculture and Fisheries. Of the thirteen members;

- Four represented fresh milk producers
- Four represented industrial milk producers
- Two represented manufacturers of dairy products
- Two represented fresh milk distributors,
- One represented consumers of dairy products.

An additional member appointed by the minister was also part of the Board. With the Dairy Control Board, they may co-opt only one person as advisory member.

Since 1983 the Dairy Control Board commenced with a process of deregulation. The following steps were done:

- The retail price controls on fresh milk were abolished as from 1 July 1983.
- Restricted registration of milk distributors was also abolished, and all applicants were subsequently registered freely, subject to the compliance with conditions of registration.
- During 1985 the retail price control on butter and cheese was lifted.
- From June 1986 the wholesale price determination of cheese and the operation of a cheese pool were ended.
- During 1986 the restricted registration of manufacturers of butter, cheese, condensed milk and milk powder was lifted.
- From 16 February 1987 only minimum purchase prices (producer prices) for fresh and industrial milk were published, instead of fixed prices as previously.
- From 1 October 1988 the wholesale price determination in respect of butter and the operation of a butter pool were abolished.

From 1988, with the implementation of a uniform marketing system for all milk (the so-called “milk is milk” system), the Board further reduced and limited the application of control measures to the essential minimum. The most important remaining functions of the then Dairy Board, according to the Annual Report of 1989, were:

- Fixation of minimum prices at which milk and cream, supplied in bulk, may be bought from producers/suppliers.
- Provision of a pool system for primary producers who elect to market their milk through the Board.
- Monitoring of prices and quality, to ensure that correct payments are made to producers and to ensure the quality of milk sold to consumers.
- Registration of pool producers, PDs, purchasers etc and determining the basic conditions of registration to be complied with.
- Imposition, collection and appropriation of levies to the benefit of the dairy industry.
- Milk diversion arrangements, surplus removals (by means of schemes or reducing of the producer floor-price), and supplementation of shortages (through an increase in the producer floor-price or imports).
- Stimulation of the demand for dairy products.
- Collecting, processing and releasing of statistical and other dairy industry information.

According to the Annual Report of 1990 of the Dairy Board, the Board appointed the Dairy Services Organisation (SDO) as its agent to perform its management, secretarial, administrative, information and communication and marketing functions. Due to re-organisation in the dairy industry the SDO was formed and registered on 19 September 1989 as a company without gain, and specifically as a services organisation for the dairy industry. The staff of the Dairy Board as well as the SA Dairy Foundation was pooled from 1 March 1990 in the SDO.

### **A.1.3 Milk Board – Post 1994**

During 1994 the democratising process in South Africa started not only on political areas, but in the dairy industry as well. The Milk Board was established on the request of the majority of milk producers. During November 1993 the milk producers voted in favour of a new Milk Scheme, as proposed by the Milk Producers' Organisation (MPO), which was subjected to thorough testing by the National Marketing Council. The new Milk Scheme was established on 1 January 1994, in terms of Government Notice 2492 of 24 December 1993 – a fully service-orientated organisation.

From the beginning the viewpoint of the Board was that all role-players within the industry are important for the future existence of the dairy industry. The services included in its strategic plan were thus based on rendering of services to the whole industry.

With the establishment of the Milk Scheme the nature of the Milk Board's activities changed considerably and differed substantially from the previous Dairy Scheme. The Milk Scheme of 1994 did not intervene in the market and there was no price control. The removal of surpluses also ceased to exist. The new Milk Board therefore focused on the rendering of services to its clients, rather than intervention in the marketplace as with the previous Dairy Board.

The Minister of Agriculture approved the request that Article 7 of the Milk Scheme may be altered to make the composition of the Milk Board more representative of the industry. The composition of the new Board was as follows (Milk Board, Annual Report, 1995/96):

- Eight persons who represent milk producer, of which one person must represent small-scale producers.
- Four persons who represent milk distributors and processors.
- One person representing consumers of milk and milk products.

The new Milk Board gave the industry the opportunity to manage their own affairs through an own organisation. The most important functions of the Milk Board were:

- To be an effective central mouthpiece for the industry.
- To keep the industry in contact with international dairy organisations.
- Inputs regarding tariffs and the monitoring of imports.
- Combating illegal imports and tariff fraud.
- Advertising and promotions
- Funding of the Milk Producers' Organisation through imposing of levies on producers.
- Representing the industry on various committees involved with the management of the dairy industry.
- Anti-mastitis actions and control of Tuberculosis and Brucellosis.
- Research for the dairy industry, as well as consumer research.
- Involvement in stock improvement and milk recording. It also provided funds for these schemes.
- The Board handled the administration of the Dairy Mark, a sought after symbol in the dairy industry.
- Publication of *The Dairy Mail*, as communication tool between the Board and producers.
- Up to date statistical data concerning the dairy industry, and making it available to all role-players in the industry.

#### **A1.4 Milk Producers' Organisation**

The Milk Producers' Organisation (MPO) was established in 1994, together with the Milk Board, to fill the gaps left by the Dairy Board. In 1998 the Milk Board dissolved and merged into the MPO. The milk producers decided that the MPO should be responsible for the essential functions such as research, information, milk recording, tariff negotiations and prevention of illegal import (Cronje *et al*, (1999)).

The Milk Producers' Organisation (MPO), as it is currently known, was established in 1998. The MPO is a voluntary producers' organisation in the form of an article 21 company not for gain, which is funded by membership fees deducted from the farmer's milk price. In 1998 it was decided to fix membership fees at the same level as the statutory levy that was fixed at 0,46 cent per litre of milk for the Milk Board.

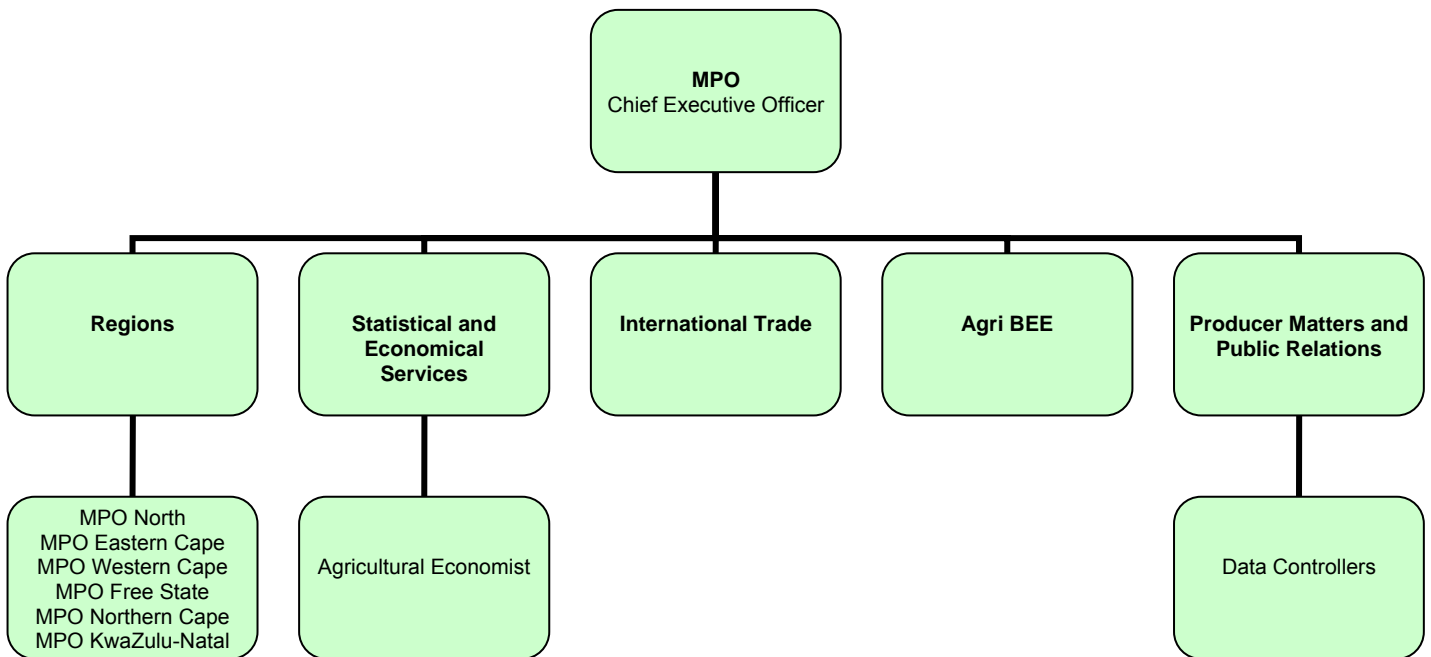
The main aim of the MPO is to deliver support services to the dairy farmers of South Africa. These services include training, research, economical and statistical services. The promotion of the dairy producer's concerns and opportunities is of cardinal importance of the MPO. Furthermore the MPO strives to promote milk consumption through various means.

According to an unpublished prospectus of the MPO, the MPO have a few sub-divisions which is responsible for various tasks. The first division is the international trade division, which is responsible for the effective management of the international environment in order to optimise the profitability of the dairy producers. Through this division the MPO negotiates for the best possible tariff structure, monitors imports for dumped products and seeks export opportunities.

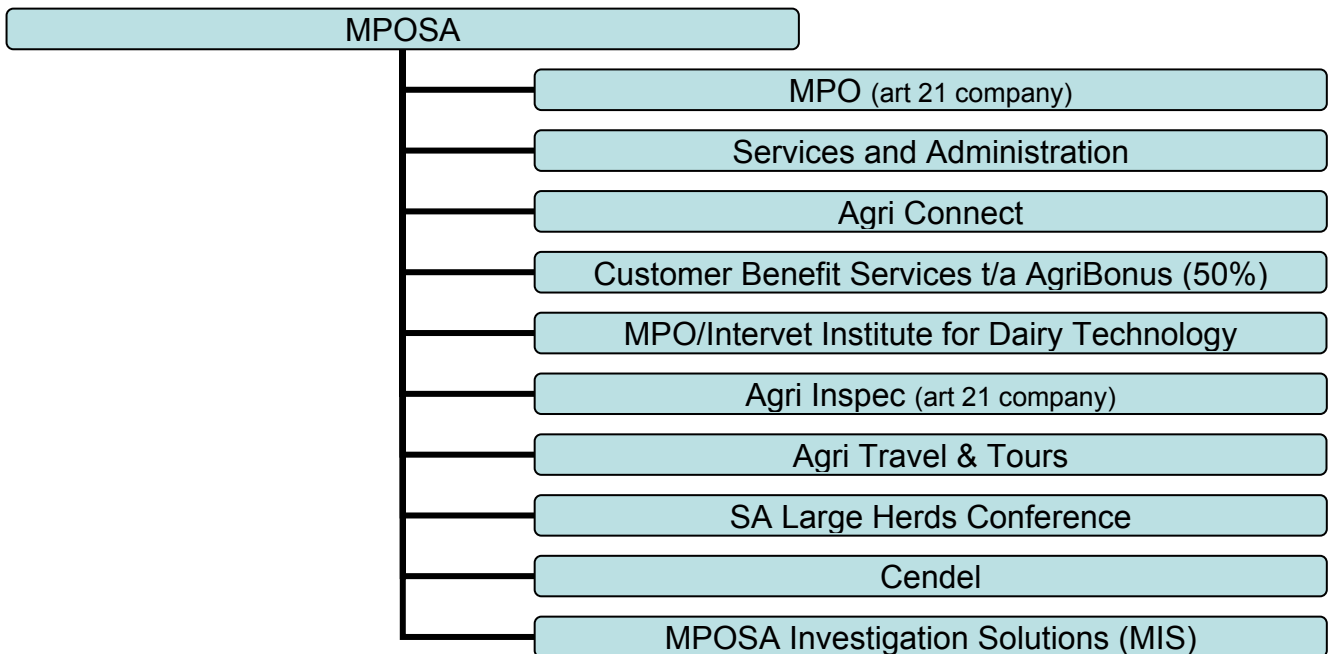
A second division of importance is the economical and statistical division, which is responsible for the collection, analysis and publishing of information. Information is important for any business, including farm businesses, to survive in the current free-market environment in South Africa.

The MPO established certain support businesses, which initially operated in the dairy industry alone, but then extended its services to the bigger agricultural industry as well. Together with the MPO, these companies form the company MPOSA, which was established in 2001.

The structure of the MPO is shown in Figure A1, with the structure and subsidiaries of MPOSA shown in Figure A2.



**FIGURE A1: Structure of the MPO**



**FIGURE A2: Structure of MPOSA**