CHAPTER 2

THE NATIONAL MILK RECORDING SCHEME FOR DAIRY COWS

Introduction

Dairy farmers in South Africa face enormous challenges to produce sufficient amounts of milk to produce dairy products of high quality and quantity to provide in the nutrient requirements of the country. Initially, capturing of milk recording information focused mainly on the phenotypic performance of individual dairy cows. This data was later used in genetic evaluation programmes towards the selection of animals of superior genetic merit. Besides the use of milk recording information for genetic evaluation, the South African performance recording system addresses the needs of herd production tendencies, milk composition, and quality, as well as production efficiency. With the worldwide tendency to larger dairy herds, especially in intensive production systems, more emphasis has recently been placed on information about the relationship between phenotypic values and health traits and nutritional requirements.

Background

Milk recording in South Africa started in 1917. State milk recorders travelled by train to perform milk recording tests on farms. From 1956, the Milk Recording Scheme was conducted on a co-operative basis with 16 co-operatives participating using 63 milk recording personnel, equipped with vehicles, to enable on-farm milk recording. The technical supervision and financial aid in the form of subsidies were provided by the Department of Agriculture. Milk recorders tested, on the farm, a milk sample of each recorded cow for its fat content by means of the Gerber test. This information on the quality and quantity of each dairy cow was then provided to farmers.

During the 1970's, because of the use of more effective milk analyzing equipment, the analyses for protein, butterfat and later also the somatic cell count (SCC) and milk urea nitrogen (MUN) contents of milk became possible. Later, because of rising costs, the concepts of centralized milk testing and also owner sampling were started in South Africa. This led to an increased participation in milk recording of cheaper and more effective services. The scheme is continuously evaluated according to international standards and adapted regularly to comply with the changing needs of clients and the latest developments in animal recording and improvement (including breeding value prediction and goal setting). ICAR accreditation is therefore needed.

Aim of the Scheme

The aim of the Scheme is to promote the biological and economical efficiency of milk production, in acceptable quantities and of acceptable quality, in the national herd by

a) identifying low producing female animals in participating herds and determining the possible causes of their poor production, and their elimination from the herd, if necessary;
b) making the necessary adjustments in management and feeding practices and recommending culling of poor performing producers;
c) estimating the potential producing ability of animals and promoting the use of proven bulls through artificial insemination; and
d) to develop value added products and services in the field of livestock improvement and to promote the use thereof.

The status and results on performance testing: 2001/2002 to 2010/2011

Dairy farmers in South Africa are increasingly under pressure to improve the efficiency of their dairy herds to ensure economic survival. Efficiency is defined as the ratio of output vs. input. It is clear that the term efficiency is meaningless without defining the outputs and inputs of the production system. At any given cost level, the greater the total economic efficiency, the greater the profit margin. The way to achieve maximum economic efficiency of milk production will differ between farms and even from year to year, depending on a large number of factors.

The average production of all dairy cows in milk recording for the decade from 2001/2002 until 2010/2011 is summarised in Table 1. During this period the performance data of all recorded animals was still captured on the Integrated Registration and Genetic Information System (INTERGIS). The total amount of completed lactations for this period was reasonably constant, around 115 000, representative of approximately 30% of all dairy cows in the country. However, the production level of recorded lactations were approximately 60% higher than for non-recorded cows.

During this period, the average milk production per lactation improved from 6609 to 6956 kg, while butterfat production improved with more than 10% from 3.73% to 4.17%. The average protein production also improved from 3.28% to 3.47%. These improvements were partially due to better management practices and effective selection decisions by dairy farmers, based on estimated breeding values (EBVs) for these production traits.

Table 1. Average production of performance recorded cows for the test years 2001/2002 and 2010/2011

Test Year	Total number of lactations	Milk production (kg)	Fat (%)	Protein (%)
2001/2002	113 652	6 609	3.73	3.28
2010/2011	115 494	6 956	4.17	3.47
Difference	+1 842	+347	+0.44	+0.19
% difference		+5.0	+10.6	+4.5

OUTLINE OF THE SCHEME

Phase A: Reproduction phase

Reproduction and calving ease traits of cows and bulls are evaluated through insemination records and calving down data.

Phase B: Lactation phase

This consists of the performance of each cow in the Scheme in terms of its (a) daily and (b) total lactation yields for milk, butterfat, protein, and lactose, and lactation somatic cell count and milk urea contents. The daily milk yield figures enable members to feed cows according to production level towards improving feeding management. Total yield figures are the basis on which animals are culled, used for commercial purposes or identified as potential dams for breeding purposes. For practical reasons, official milk performance recording is done on a 5-weekly basis on 10 milk recording events over a calendar year. At each milk recording event, the actual 24-hour milk yield of

each lactating cow in the herd is recorded. A milk sample of each cow is also collected which is then analysed for fat, protein, lactose, SCC and MUN by a central laboratory at the ARC's head office in Pretoria. Total lactation yields are then calculated over a 305-day period. The lactation period can also be extended beyond 305 days in the case of high producing cows. This creates the possibility of determining the lifetime performance of dairy cows. Extended lactations are also standardized to a 305-day period for evaluation purposes. Research has proven that the correlation between daily and 5-weekly production statistics is very high.

The phenotypic value for a specific trait for each animal is measured and therefore available. In using BLUP methodology, it is possible to estimate the contribution of the genetic production ability and the environmental effects that influences actual production for a trait. Genetic improvement for a trait is permanent, while favourable environmental effects only enhance production as long as the circumstances apply. The following equation reflects this hypothesis:

$$V_P = V_G + V_E$$

where V_P = Phenotypic Value for production traits, e.g. milk, butterfat, and protein production,
V_G = Genetic Production Ability for a specific trait, and
V_E = Environmental effects, e.g. influences due to feeding and management practices.

BLUP is the acronym for 'Best Linear Unbiased Prediction'. BLUP is the best available estimation of the 'actual' breeding value of an animal (for most production traits).

BREEDING VALUE (EBV) – Estimated breeding value (EBV) is the BLUP breeding value of an animal and is an estimation of its genetic ability (value) as a parent in a breeding programme. The measurement, e.g. milk yield, of an animal is influenced by the environment the animal is kept in, e.g. herd, rainfall, nutrition, age of the dam, etc, as well as the animal's own genetic potential for milk yield. The animal's breeding value is estimated by:

- Comparing the animal to its contemporaries or group partners, i.e. those animals exposed to exactly the same environmental conditions. The differences between animals is then directly attributable to genetics,
- Using all information available for an animal's relatives, and
- Making use of genetic linking between herds.

Estimated breeding values for traits are presented in the unit that traits are measured, e.g. kg for milk production, etc. EBVs are used to predict how the future progeny of an animal should perform within the breed. An animal's EBVs are based on all the performance and pedigree information of itself and related animals within the INTERGIS database. Within year and analysis, EBVs are comparable to each other. An animal with a breeding value of, for example +180 kg for milk production, will genetically be a higher producer than an animal with a breeding value of +20 kg, regardless of the environment they are kept in.

As more information about an animal's performance becomes available, its breeding value becomes more accurate. Accuracy varies between 0 and 99%. The accuracy of every EBV will depend on the reliability and completeness of performance records and pedigree information. It is a function of the heritability of the trait as well as the contemporary group

composition and group size. It is therefore essential that all information should be recorded as precisely and accurately as possible. The more accurately data is recorded, the more reliable breeding values will be estimated to enhance accurate selection of superior animals.

The genetic profile for each herd, as well as the genetic trends for the measured and available traits, is presented to the farmer in the form of a herd profile document. This information enables the farmer to accurately select superior animals based on his selection criteria. The genetic profile also reflects the inbreeding coefficient of every animal, as well as the inbreeding level of the herd and the breed as such. It is therefore possible to manage inbreeding by applying corrective mating where necessary.

GENERAL ROUTINE FOR MILK RECORDING

Organization in respect of a milk recorded herd.
Each member must apply for membership of the National Dairy Animal Improvement Scheme and supply his address and any other particulars that may be required, regarding the farm and parlor on which the scheme will be applied. All the cows of the same breed on this farm will constitute a single recorded herd.

Equipment
Only milking machines and milk meters, or similar apparatus officially approved by international standards, may be used. The milk meters must be calibrated to the nearest 0.2 kg and must be able to take a representative milk sample.

Determining the mass of milk
Lactation results are based on twice (2X), three times (3X), and more milking sessions per day. Cows are classified as milked 3X if they have had one or more 3X milking sessions and the herd will be classified as a 3X milked herd if more than 40% of the cows are milked 3X.

Collecting and testing of milk samples
The mass of milk will be measured to the nearest 0,2 kg and a minimum of 2 kg of milk is required to qualify for an official test. A sample consists of 28 milliliters of milk in a sample bottle with a preservative. This sample will be tested for a minimum of butterfat, protein and lactose, but also for somatic cell count and milk urea if required. The single sample will be projected to a composite 24 hour value using a formula that takes into account the hours in-between each milking and the ratio of the kilograms of milk produced at each milking. Only lactations with five or more tests will be considered as official. Lactations with less than five tests will be marked as unreliable.

Calculation of performance
Lactation milk yield:

Using the standard lactation curves estimated for each breed, each age group and each season of calving, a daily production is determined which is used to determine the projected 305-day milk yield of each cow.

Lactation butterfat/protein/lactose yield:

Each test carried out will contribute to the estimation of butterfat, protein and lactose yield. The butterfat/protein/lactose yield will be calculated by

multiplying the total mass of milk recorded for the period by the percentage of butterfat/protein/lactose for the period, divided by 100.

Lactation butterfat/protein/lactose percentage:

The total yield of milk, butterfat, protein and lactose will in turn be used to calculate the percentage butterfat, protein and lactose for the lactation, as obtained in the calculations for production traits.

Herd averages:

Herd averages will be calculated for each test year, using the 305-day projected lactations. Herd averages will include, amongst others, the following:

Average milk yield for 305 days;
Average butterfat yield and percentage for 305 days;
Average protein yield and percentage for 305 days;
Average lactation length (days in milk);
Average age at first calving (months);
Average calving interval between 1st and 2nd calving dates;
Average calving interval for all the cows in the herd;
Average somatic cell count (SCC); and
Average milk urea nitrogen (MUN).

FEEDBACK TO PARTICIPANTS

Great improvements have been made in the past few years in making performance and registration data in various forms available to our participating farmers through INTERGIS (with the following website address: www.intergis.agric.za). Various programmes have also been put in place in INTERGIS to assist in the efficient running of IRIS. Several outstanding reports, in addition to the IRIS reports, have been generated, and are of great assistance to farmers towards improving their standard of management. The following information is provided following milk recording:

1. With every completed lactation, a comprehensive certificate will be generated indicating the production levels for milk, butterfat, protein, intercalving period (ICP), somatic cell count (SCC), updated lifetime production, as well as a complete 3-generation pedigree of the animal.

2. Following every official milk recording, the following reports on production performance are available:

   (a) Summary of the test day data. This includes results on the average and total production, as well as the predicted 305-day average for each cow.
   (b) A production report (animal report) for all cows tested on that specific day. The focus is on total production of each cow at that stage of the lactation as well as the projected 305-day production data. This information provides the opportunity to select or cull a cow at a relatively early stage of the lactation, since gross income per cow is also calculated.
   (c) In addition to the official reports mentioned above, numerous relevant reports are also available through INTERGIS. There are two distinct categories, namely:

Reproduction and Performance related reports. The following reproduction reports are available :

(i) Herd reproduction report
(ii) Herd status report
(iii) descriptive reproduction report

The following performance related reports are available :

(i) Breeding herd selection report
(ii) International breeding values for bulls
(iii) BLUP blood hound (searching tool for specific bulls)

3. Herd averages over a test year period (calendar year) within breed, region and age groups are available each year. It is therefore possible to evaluate a herd's performance against other herds within a region and on a national basis.

4. Recently more emphasis was placed on information regarding the relationship between phenotypic values, health traits, and nutritional requirements. The intensive production systems in the dairy industry demand creative, dynamic, and interactive reports, to ensure economic sustainability for dairy operations. Therefore, it was necessary to develop more advanced functionalities in the management programme, to assist dairy farmers in timely decision making in improving cow efficiency. State of the art technology was used to develop these functionalities. This functionalities enable the farmer to get more practical information from milk recording data, with a specific focus on economically important traits such as SCC and MUN. This information is also available in INTERGIS through Livestock Manager.

In closing

Participation in the National Milk Recording Scheme includes the following benefits:

1. The Scheme makes use of modern technology when production data is calculated to be utilized in farm management decisions. It incorporates accurate projections based on both own individual cow and herd data.
2. The actual production per lactation for milk, fat and protein, factors affecting the milk price, are calculated for each cow. Efficient producers are identified for use in future breeding programmes, as well as poor performing cows reducing herd profits.
3. The genetic potential of animals is determined through BLUP breeding values. Based on this, cows could be directly evaluated within the breed across herds.
4. Herd genetic trends over production years are determined giving an indication of the herd's genetic progress for production parameters.
5. By using breeding values and genetic trends, a well-planned breeding policy can be applied in order to meet future market requirements.
6. Health problems within the herd can be monitored through analyzing the somatic cell count (SCC) of individual cows.
7. The feeding status of cows can be monitored through analyzing milk samples of individual cows for milk urea nitrogen (MUN).
8. The sale value of animals of superior genetic merit is higher when production data is available.